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Human Papillomavirus (HPV) Concordance in Heterosexual Couples

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Abstract

Purpose—Few studies have examined the relationships between sexual or hygienic behaviors and HPV transmission. Our objectives were to (1) describe HPV concordance between the anogenital, oral and palmar areas of monogamous, heterosexual couples and (2) determine sexual behaviors, hygienic practices, sexual histories and characteristics associated with HPV anogenital concordance.

Methods—Couples were recruited from women who developed an incident HPV infection while enrolled in a longitudinal HPV natural history study that recruited from 2 family-planning clinics. Men were their monogamous partners of at least three months. Samples were tested for HPV-DNA of 37 high- and low-risk genotypes. Questionnaires completed privately assessed health, sexual, hygienic history and behaviors.

Results—25 couples enrolled between February 2006 and July 2007; none had received HPV vaccine. The average age was 25 years (SD 6) for men and 23 years (SD 3) for women. HPV-84 was the most commonly shared HPV type in the anogenital and palmar areas. HPV-16 was the only shared oral-HPV type. 68% of couples had type-specific anogenital concordance. Receiving finger-anal sex (p=.05), sharing towels (p=.04), longer time since last intercourse (p=.03 women and .02 men), and men washing their genitals after sex (p=.03) were associated with decreased likelihood of concordance. Persistence of incident HPV types in women was associated with HPV in men (p=.002).

Conclusions—Our findings show that certain hygienic and sexual behaviors are associated with anogenital concordance between healthy, monogamous, heterosexual couples. Future studies are needed to see if these detections reflect contamination, transient or established infections.

Keywords

Human Papillomavirus; male; concordance; hygiene; sexual behaviors; cutaneous; oral; genital; transmission; persistence

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Human Papillomavirus (HPV) is recognized as the most common sexually transmitted infection in men and women. Early studies of couples showed low concordance of HPV infection between sexual partner's genital areas, ranging from 2% to 40% [1–7]. Although recent data, with improved HPV-DNA detection methods and more standard sampling techniques, suggest higher rates of concordance, they remain well below 100% with rates ranging from 37% to 68% [8–10].

The determinants of concordance between sexual couples are poorly understood and few factors have been shown to be associated with concordance in healthy couples. Higher HPV viral loads may be associated with an increase in concordance, but this finding is inconsistent. Direct comparison of these studies is difficult since reports lack information on the time between sampling of partners [7,10,11]. Additionally, faster clearance in one partner may explain lack of concordance when couples are examined cross-sectionally; longitudinal studies suggest men clear genital HPV faster than women [12,13]. Few studies have examined behavioral factors commonly attributed to the spread of infectious agents such as specific sexual practices and sharing of hygiene products.

Certainly, one of the factors potentially affecting concordance is the type of sexual relationship. Partners in transient relationships may have less time to pass an infection whereas monogamous partners who have sex frequently may transmit HPV more successfully if an infection is introduced into the relationship by pre-existing or latent infections. Another factor may be the stage of HPV infection. Many studies have focused on women with later stages of HPV infection including women with invasive cervical cancer [5], which may be less likely to shed infectious particles, and women with abnormal cytology [2,4,6,8,9], which is associated with higher viral loads. Also, studies of concordance have focused primarily on the genital area. It is known that anogenital HPV genotypes can be detected from non-anogenital sites such as the oral cavity and surface of the hand [14,15]. To date, little is known about the concordance between couples when multiple sites are considered.

The objectives of this study were to (1) describe HPV concordance between the anogenital, oral and palmar areas of monogamous, heterosexual couples and (2) to determine sexual behaviors, hygienic practices, sexual histories and characteristics of individuals and couples that are associated with HPV type-specific anogenital concordance between sexual couples.

Methods

Participants

Female partners were recruited from participants of an on-going natural history study of HPV that enrolled women aged 13 to 21 years who were attending 1 of 2 family planning clinics from 1990 to 1994 and 2000 to 2004 in California. Participants have a study-visit every four months during which demographic and behavioral information are obtained. Cervical HPV testing, cytology and colposcopy are performed [13,16–18].

Women were identified for recruitment into the couples' study if they had an incident cervical HPV type detected at the most recent natural history study visit. Incident cervical HPV type was defined as a cervical HPV type detected that was not detected on the previous visit. These women were eligible for recruitment if they were in a monogamous, heterosexual relationship of at least three months duration, not pregnant, had normal cytology and had no current history of genital warts.

Women's eligibility was determined by review of study chart and confirmed in conversation with the women by study staff. Each eligible, interested woman was asked to obtain permission from her partner for the study staff to contact him. The study, including confidentiality and

eligibility, were explained to men privately via telephone. Eligibility criteria for men included self-reported monogamy for three months or longer, not having genital warts and no use of medication in the genital area at the time of enrollment. Men and women were allowed to opt out at any point without stating a reason. All subjects were 18 years or older and provided informed consent. The Institutional Review Boards of University of California, San Francisco; San Francisco State University; University of Cincinnati; and Cincinnati Children's Hospital Medical Center approved this study.

Procedures

Couple's visits occurred within eight weeks of the woman's visit at which the incident cervical HPV was detected. Partners were sampled for HPV on the same day. Each participant completed a self-administered paper-pencil questionnaire privately and separately from his or her partner. Information collected by questionnaire included: participant's demographic characteristics, health history, sexual history and recent sexual and hygienic behaviors. No information was shared with partners.

A trained clinician collected samples from each participant in private. Each HPV-DNA sample was collected using separate supplies, including gloves. All swabs were sterile Dacron. In women, a swab was placed 2 cm into the anal canal and rotated 360° conically three times, a swab was used to scrape the vulvar area (introital, labia minor) three times on each side and a swab was used to scrape the vaginal walls three times. The cervix was sampled using a 5mL, normal-saline, cervicovaginal lavage. Cervical cytology was obtained after HPV-DNA samples using a cytobrush and spatula. Cells were immediately transferred onto a glass slide and placed into methanol [16,18,19]. In men, the glans, including corona sulcus; shaft; inner foreskin, if applicable; scrotum and perianal area were sampled separately using textured papers (2cm by 3cm 600A-grit Wetordry Tri-M-ite) to exfoliate each site prior to wiping with normal-saline moistened swabs. In men and women, the palmar surface, including fingers, of the dominant hand was sampled using one textured paper and moistened swab per subject. Oral samples in men and women were collected from the buccal mucosa and tongue with a cytobrush [20,21]. Swabs and cytobrushes were immediately placed into separate vials of sample transport media (QIAGEN Inc., Valencia, CA). Textured papers were placed into separate, dry cryovials. Specimens were stored and tested in Dr. Moscicki's laboratory.

HPV-DNA detection used Linear Array HPV Genome Typing Test™ (Roche Molecular Systems, Pleasanton CA) [22,23] for 37 anogenital genotypes (6, 11, 16, 18, 26, 31, 33, 35, 39, 40, 42, 45, 51–59, 61, 62, 64, 66–73, 81–84, IS39 and CP6108) per manufacturer's instructions. Human β-globin DNA served as a positive control. Samples were prepared using QIAamp MinElute Media Kit (QIAGEN Inc. Valencia, CA). One pathologist read all cytology.

Analyses and Statistical Methods

Results from individual samples from the anogenital area (vulva, vagina, cervical, and anal samples in women and glans, shaft, foreskin, if applicable, scrotum, and perianal areas in men) were combined for analysis after HPV-DNA testing since the sample size precluded analysis of individual sites. Samples with negative β-globin and HPV-DNA signals were considered inadequate and excluded from analysis. By definition, all women in the study were HPV positive within eight weeks of the baseline visit of this transmission study. Therefore, type-specific concordance was defined as the co-occurrence of an HPV type in both partners (positive concordance) or as the absence of all HPV types in both partners (negative concordance). Persistence was defined as redetection of the incident, cervical HPV type in the woman's anogenital area at the couple's visit.

Two-tailed p-values for comparisons between men and women were obtained from sign-rank tests for interval variables and McNemar's tests for dichotomous variables. Measures of agreement within couples are Spearman rank correlations for interval variables and Kappas for dichotomous variables. All p-values associated with tests of association between type-specific concordance and any predictors are mid p-values from a conditional exact test using the "score" method [24,25]; odds ratios (ORs) are exact with exact mid-p confidence limits, each was obtained from SAS Proc Logistic. The use of conditional exact tests and mid-p values was chosen *a priori* because of our small sample size [24,25]. Mid-p values for 2×2 tables are the Fisher's exact p-values (sum of the probabilities of the observed table under the null hypothesis plus those of all possible tables as probable or less probable than the observed table) minus ½ the probability of the observed table. Note that mid-p significance tests share with Fisher's test the possibility of attaining a two-tailed value less than .05 while the OR's exact 95% confidence interval (CI) includes 1. This is because the 95% CI for the OR is centered in the sense that 2.5% of the probability is beyond each end of the CI. The test of independence, however, may be uncentered in that the one-tailed p-value is not necessarily ½ the two-tailed value. Other comparisons of independent proportions were tested using two-tailed Fisher's exact tests. The study alpha was .05, two-tailed and p-values were not adjusted for multiple comparisons. The intention of these analyses was to generate hypotheses regarding subject characteristics and behaviors and therefore did not include multiple infections or oncologic risk of HPV types.

Results

Subject Characteristics and HPV Detection

Twenty-five couples were enrolled between February 2006 and July 2007. No subjects had received HPV vaccination. Forty-four of the 79 women (56%) eligible for the study provided permission to contact their partners. Eight men could not be contacted and three were ineligible, leaving 33 (75% of recruited men) eligible for enrollment. Eight couples did not enroll. Of the enrolled couples, twelve lived together. Rates of reported sexually transmitted infections, smoking, alcohol and substance use for men and women are summarized in Table 1. Few couples used condoms and the majority of men (64%) were circumcised. The average age of men was 25 years (S.D. 6 years). The average age of women was 23 years (S.D. 3 years) (p=.001). Men reported a longer period of time since the couple last had intercourse than did women (p=.02). Although men reported the first time the couple had sex to be more recent than did women, the difference was not significant (Table 1). Agreement of reported characteristics and behaviors within couples is shown in Table 1.

Table 2 shows the distribution of anogenital, palmar and oral HPV types at the couple's visit and the incident types detected in women prior to the couple's visit. Each partner had adequate samples from their palmar site and anogenital area. One woman had an inadequate oral sample. The most common types detected in the anogenital area of men were HPV 84 (24% of men), 16 (20%), 52, 53, 39 (16%). The most common types of HPV detected in the anogenital area of women were HPV 84 (24% of women), 52 and 53 (20%), and 39 and 16 (16%).

Type-Specific Anogenital Concordance and Persistence of the Incident HPV Type

Type-specific anogenital concordance occurred in 68% of the couples (n=17). Three couples had negative concordance, 14 couples had positive concordance for 1 to 5 types (Table 3). The most commonly shared type between partners' anogenital areas was 84, found in five couples (20%) followed by 39, 52, and 62, found in three couples each (12%).

Type-specific concordance at the palmar area was 68% (n=17 couples). Of these, 13 couples (52%) were HPV negative and four couples (16%) shared at least one HPV type; two couples

shared one type and two couples shared two types. The most commonly shared type between partners' palmar area was 84, found in two couples (8%). Oral HPV was rarely detected; twenty-one couples (87.5%) were negative for oral HPV. Only one couple had both partners with oral HPV; they shared type 16.

Persistence of the incident HPV type occurred in 18 women (72%). Men were more likely to be HPV positive for any HPV type in their anogenital area if their partner had persistence of the incident HPV type. Specifically, of the 18 male partners of women with persistence, 17 (94%) were HPV positive. Of the 7 male partners of women without persistence, 2 (29%) were HPV positive (p=.002). Also, there was a trend toward an association between detection of the woman's incident HPV type in the male partner's anogenital area when the woman had persistence of the incident HPV type. Specifically, of the 18 male partners of women with persistence, 11 (61%) were positive for the woman's incident HPV type. Of the 7 male partners of women without persistence, only 1 (14%) was positive for his partner's incident HPV type (p= .07).

Shared HPV between partners' non-anogenital and anogenital areas

Detection of the same HPV types in one partner's palmar and the other partner's anogenital area occurred in 11 couples (44%). The most common HPV type shared between the palmar area of one partner (either male or female) and the anogenital area of the other partner was type 84 followed by types 51, 39 and 52. Of the seven couples with one or both partners negative for HPV in the anogenital area, no couples had HPV detected in their palmar area. Of the 18 couples with both partners positive for HPV in their anogenital areas, 66% (n=12) had HPV detected in their palmar areas (p=.005).

The couple with type-specific concordance at the oral area for HPV type 16 did not have type 16 found in either partner's anogenital area. Of the two couples in which HPV was detected in one partner's oral area, one couple had the same HPV type detected in the other partner's anogenital area. Although not statistically significant, oral HPV was detected only in couples in which both partners were positive for HPV in the anogenital area compared to couples in which one or both partners were negative for anogenital HPV (p=.53).

Risk Factors Associated with Type-Specific Anogenital Concordance

Couples were less likely to have type-specific anogenital concordance the longer the time (in hours) between having sex and being sampled for HPV (OR= .98, 95% CI: .95–1.0, p=.03 for women and OR=.98, 95% CI: .96–1.0, p=.02 for men). Concordance was less likely if the man reported washing his genital area between having intercourse and being sampled for HPV (OR=.16, 95% CI: 0–1.0, p=.03) or if the woman reported receiving finger-anal sex (OR=.12, 95% CI: .00–1.42, p=.05), sharing a towel (OR=.15, 95% CI: .02–1.1, p=.04) or sharing a razor (OR=.19, 95% CI=0–1.6, p=.05) with her partner in the past week. Table 4 shows ORs for self-reported behaviors and health histories from male and female partners associated with type-specific anogenital concordance at a p-value of .10 or less. Factors including male circumcision; duration of monogamy; years sexually active; frequency of vaginal intercourse; the number of days between detection of the incident HPV type and the couple's visit; and other variables listed in Table 1 were not associated with concordance.

Discussion

This is the first study to our knowledge that examines specific hygienic factors associated with HPV concordance in heterosexual couples. Our study is also unique in that it looked at concordance when the female partner had a recent history of incident HPV infection and normal cytology. Although the number of couples was small, we were able to assess detailed histories

of specific sexual and hygiene-related behaviors. We believe several of our findings are worth discussion.

To our surprise, we found several relationships between hygienic habits and discordance. Specifically, women who reported sharing a razor or towel with their partners had an increased chance that they would be discordant. This finding appears contradictory to assumptions about HPV transmission; however, very little is actually known about factors that influence HPV detection patterns in couples. We hypothesize that in this case, shared razors and towels pass exfoliated cells infected with HPV DNA from one partner to the other. These exfoliated cells likely come from extra-genital sites (e.g. thighs, pubic hair, etc.) not sampled in the partner. Detection of HPV from the exfoliated cells likely reflects contamination (i.e., the viral DNA is detected because of the infected cellular debris), not an established infection. The detection of HPV from these sloughed cells versus established infections is likely to result in discordance. In this scenario the virus has not entered the subject's basal cell layer and established active replication, rather the HPV-DNA PCR test detects the HPV DNA from the partner's squamous cell. The possibility of contamination by HPV passed between partners was underscored by our finding that men who washed their genitals after sex were more likely to be discordant. Cleaning the genital area after sex may reduce the infectivity of men.

Other findings from our study support the notions that cellular debris with HPV infection or rapidly cleared infections have a role in determining concordance in cross-sectional sampling. The shorter time since a couple had sex, the more likely the same HPV type would be found in both partners. This finding is consistent with the trend toward association found by Baken, *et al.* [1] in whose study a shorter number of days since last intercourse was weakly associated with increased chance of anogenital concordance between sexual couples. This suggests that either HPV detected in one partner may be simply a contaminant from the other partner that does not result in prolonged infection or that the natural history of HPV infection in men is different than in women with men clearing infections faster than women [12,13].

The type of sexual activity also appeared to affect concordance. Finger-anal sex in women enhanced anogenital discordance. Our finding may indicate that this particular act results in a higher chance of contamination, and thus discordance, of one of the partners. On the other hand, anal HPV infections, in women particularly, have been shown to clear more rapidly than cervical infections [26].

The notion that many HPV-DNA detections are not established infections is underscored by the finding that men who were partners to women with persistent HPV infection were more likely to have HPV detected. Whereas men whose partners did not have persistence of the incident HPV type were unlikely to have HPV detected.

The rate of almost 70% HPV type-specific concordance is higher than rates reported by others when using the same definition of concordance. In Italy, Benevolo *et al.* showed a 30.9% concordance rate. In this study couples reported at least 12 months of monogamy and the women had either a current or past history of CIN or HPV [8]. Baken *et al.* found a concordance rate of 37.8% in couples from the United States who were recruited from STD clinic regardless of history of monogamy [1]. In another study of Dutch couples in which the woman had prevalent CIN lesions and recruited without regard to monogamy 39.8% were concordant [3]. We believe our higher rate of concordance was partly due to our selection of women with known, recent, incident infection and normal cytology. The higher rate of concordance suggests that HPV may be rapidly transmitted shortly after infection. In contrast, partners of women with CIN, who show lower rates of concordance, may have developed an immune response and cleared the HPV infection by the time the male partner was tested.

Our rate of 8% oral HPV in men and women is similar to pervious studies using oral rinse sampling that reported rates of 5% to 8% [27–29] and lower than a study using cytobrushes to sample Finnish spouses which showed a prevalence of 16% in women and 18% in men [30]. Little comparable data are available for HPV detection in the hand. It is interesting to note in this study, HPV was never found in a person's palmar area if the anogenital area was negative. This suggests to us that HPV detected in the hand is primarily a contaminant and not an established infection. Future studies should include HPV testing of the hand in order to determine whether it is a meaningful mode of transmission [15].

Limitations of this study include a small sample size. We attempted to narrow our search by using restrictive eligibility criteria in order to decrease baseline variability of the subjects and by using an *a priori* analysis plan using statistical methods appropriate for small sample sizes.

Regardless, reported associations should be considered suggestive and appropriate for consideration in future studies. Although monogamy was part of the eligibility criteria and reported by all participants, we acknowledge that self-reports may not reflect the true rates despite our efforts to ensure confidentiality and privacy to enhance truthfulness. Additionally, we required three months or longer of monogamy. Winer *et al.* [31] found that exposure to a new partner up to eight months prior to HPV sampling was associated with an incident infection. Therefore, the incident infections in the women may have been from contact with other partners beyond the three months. Determination of associations between oral or palmar HPV detection and specific behaviors, such as deep kissing and hand holding, is limited by a lack of information collected.

This study included women with previous HPV exposure. Concordance rates in couples with HPV-naïve female partners may be different since HPV-naïve women will not have developed a cell-mediated immune response to the previously cleared HPV infections. This would result in a longer time of persistence before clearance, thus increasing the chance of concordance. Although we identified incident cervical HPV types in women occurring prior to the couple's visit, the rate of prior anogenital HPV infections is unknown. A longitudinal study is necessary to examine the role of persistent and latent infections on transmission.

In summary, recent sexual behaviors and hygienic habits show a pattern of association with concordance between sexual partners that suggests HPV-DNA detection on cross-sectional sampling may be due to contamination. The transient nature of recent, incident HPV infections is underscored by the fact that incident HPV types were no longer detected in nearly one-third of the women after eight weeks. Longitudinal studies will be critical to elucidate the apparent importance of transient HPV infections. Our data underscore the importance in examining recent sexual and hygienic behaviors in studies of concordance.

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Table 1

Subject Characteristics Including Demographic; Life-Time Health and Sexual History; and Recent Sexual Behaviors and Sharing of Hygiene Products.

	Men		**Women**		**Comparison of Amounts**	**Agreement within Couples**
DEMOGRAPHICS:	mean	(SD)	mean	(SD)	signed rank, 2-tailed p	Spearman correlation
Age in years	25.5	(6.1)	22.6	(3.4)	.001	0.63
	n	(%)	n	(%)	McNemar's 2-tailed p	Kappa coefficient
Race						
White	7	(28.0)	10	(40.0)		
Black	6	(24.0)	3	(12.0)		
Latino/Hispanic	6	(24.0)	1	(4.0)		
Other [a]	6	(24.0)	11	(44.0)		
Attended some college or higher	9	(36.0)	17	(68.0)	.02	.27
LIFE-TIME HEALTH AND SEXUAL HISTORY:	n	(%)	n	(%)	McNemar's 2-tailed p	Kappa coefficient
Mostly or always use condoms with partner	3	(12.5)	1	(4.2)	.50	.47
Any sexually transmitted infection[b]	7	(28.0)	11	(44.0)	.34	.16
Genital warts	1	(4.0)	5	(20.0)	.22	−.07
Current cigarette smoker	11	(44.0)	12	(48.0)	1.0	.59
Circumcised [c]	16	(64.0)	na			
	median	(25^{th}, 75th%ile)	median	(25^{th}, 75th%ile)	signed rank, 2-tailed p	Spearman correlation
Number of opposite-sex, life-time partners	12	(5, 20)	7	(4.5, 13)	.04	.22
Months since sex with someone other than partner	12	(8.7, 36)	16.5	(7.2, 36)	.11	.65
Months since first time had sex with partner	26	(8.5, 42)	32	(9, 49)	.50	.87
	mean	(SD)	mean	(SD)	signed rank, 2-tailed p	Spearman correlation
Age at first intercourse	14.6	(2.1)	14.7	(2.3)	.74	.01
Years sexually active	10.9	(6.8)	7.8	(4.4)	.03	.34
DURING THE WEEK PRIOR TO HPV TESTING:						

	Men		Women		Comparison of Amounts	Agreement within Couples
Number of times a subject reported he/she:	mean	(SD)	mean	(SD)	signed rank, 2-tailed p	Spearman correlation
had vaginal intercourse	4.6	(4.4)	4.6	(3.7)	.63	.80
gave oral sex	3.5	(6.9)	1.9	(3.1)	.82	.54[d]
received oral sex	3.7	(6.1)	2.5	(4.1)	.28	.42[d]
Number of subjects who engaged in the following:	n	(%)	n	(%)	McNemar's 2-tailed p	Kappa coefficient
mostly or always use condoms with partner	3	(12.0)	2	(8.3)	.50	.47
gave finger-anal sex	6	(25.0)	1	(4.2)	.13	−.08[e]
received finger-anal sex	2	(8.0)	4	(16.7)	.69	−.13[e]
used marijuana one or more days	11	(44.0)	12	(48.0)	1.0	.44
drank alcohol one or more days	17	(68.0)	16	(64.0)	1.0	.38
shaved genital area	2	(8.0)	15	(62.5)	<.001	−0.03
shared the following with partner:						
washcloth	7	(28.0)	6	(25.0)	1.0	.26
towel	10	(40.0)	8	(33.3)	.69	.47
razor	1	(4.0)	2	(8.3)	1.0	−.06
AT THE TIME OF THE COUPLE'S VISIT:	n	(%)	n	(%)	McNemar's 2-tailed p	Kappa coefficient
LSIL/ASCUS	na		5	(22.7)		
Number reporting washed genitals after last sex	17	73.9	19	79.2	.63	.49
	median	(25^{th}, 75th%ile)	median	(25^{th}, 75th%ile)	signed rank, 2-tailed p	Spearman correlation
Hours since had vaginal intercourse	24	(12.5, 48)	20	(12, 48)	.02	.95
Hours since washed genital area	4	(2, 20)	6	(3,17)	.75	.39

Note. SD = standard deviation; percentages are of the number of respondents; LSIL/ASCUS = low grade squamous intraepithelial lesion or atypical squamous cells of undetermined significance detected on cervical cytology at the time of couple's HPV testing; na = no data expected.

[a] Includes: Asian; Native Hawaiian or other Pacific Islander; American Indian/Alaska Native, self-reported mixed race.

[b] Includes self-report of: gonorrhea, genital warts, genital herpes, trichomoniasis, syphilis in men and women, pelvic inflammatory disease in women, and responses to "any STD that you can't remember the name of."

[c] Circumcision as documented by clinician's exam.

[d] Women's report of giving oral sex compared to partner's report of receiving oral sex = 0.75. Men's report of giving oral sex compared to partner's report of receiving oral sex = 0.82.

[e] Women's report of giving finger-anal sex compared to partner's report of receiving finger-anal sex = .65. Men's report of giving finger-anal sex compared to partner's report of receiving finger-anal sex = .49.

Table 2

HPV types detected in each partner from anogenital, palmar and oral areas during couple's visit and incident HPV types detected in women prior to couple's visit

Couple	Incident HPV Type	Anatomical Area Sampled During Couple's Visit		
	CVL	Anogenital	Palmar	Oral
A Male	na	—	—	—
A Female	40 53 59	—	—	—
B Male	na	—	—	—
B Female	31 62	—	—	—
C Male	na	—	—	—
C Female	16	—	—	—
D Male	na	84	84	—
D Female	83	84	59 66	—
E Male	na	16	16	—
E Female	16	16	16	—
F Male	na	83	—	—
F Female	61	6 61 83	—	—
G Male	na	39 62	62	—
G Female	39	39 16	—	—
H Male	na	35 52 62	—	—
H Female	62	54 62	35 59 61	—
I Male	na	52	6	—
I Female	6	6 52	—	—
J Male	na	16 73 84	73 84	—
J Female	73 84	73 84	73 84	—
K Male	na	51 52	51 52	—
K Female	51	51 52	51	—
L Male	na	16 31 45 53 62 66 84	CP6108 16 31 73	—
L Female	31 62 84	31 54 55 62	—	16
M Male	na	39 84	16	—
M Female	39 84	39 84	39 84	—
N Male	na	51 82 67	—	—
N Female	51	51 82 67	51	—
O Male	na	53 55 58 70 59 62	—	—
O Female	52 53 58	18 52 53 55 58 67 70	—	IA
P Male	na	58 84 52 16 39 42 53 67	16 39 42 51 52 53 58 84 67 CP6108	—
P Female	53 68 42 84	58 84 39 42 51 52	58 84	—
Q Male	na	70 18 84 53	18 84 70	16
Q Female	70 84	70 18 84	—	16
R Male	na	—	—	—
R Female	51 52 58	61	—	—
S Male	na	—	—	—
S Female	59	54	—	—

Couple	Incident HPV Type	Anatomical Area Sampled During Couple's Visit		
	CVL	Anogenital	Palmar	Oral
T Male	na	—	—	—
T Female	54	53 54 CP6108	—	—
U Male	na	40	—	—
U Female	40 45	—	—	—
V Male	na	61	—	—
V Female	16	16 54cp6108	—	—
W Male	na	CP6108	—	—
W Female	16 51 53 61	16 51 53 61	—	—
X Male	na	59 66	—	—
X Female	39	39 42 51 52 53 58 84	—	—
Y Male	na	16 39	—	39
Y Female	53	53 67	—	—

CVL = cervico-vaginal lavage; NA = no result expected for this subject; — = negative for HPV-DNA; IA — human β-globin negative and HPV DNA negative sample.

Table 3

Number and Percent of Couples with Type-Specific Anogenital Concordance.

Concordance Criteria	Number of Couples	Percent of All Couples
Negative concordance	3	12
Positive concordance, number of types		
1	6	24
2	4	16
3	2	8
4	1	4
5	1	4
Total	17	68

Table 4

Hygienic Characteristics and Sexual Behaviors Associated with Anogenital-Type-Specific Concordance at a p-value =<.10 as Reported by Female and Male Partners.

REPORTED HYGIENIC CHARACTERISTICS OR SEXUAL BEHAVIORS	Exact OR	(95% Confidence Limits)	p-value
Female partner's cytology and self-reported history and behaviors:			
LSIL/ASCUS at time of couple's visit	5.100	(.804, Infinity)	0.08
Shared towel with partner in past week	.153	(.019, 1.017)	.04
Received finger-anal sex	.124	(.004, 1.418)	.05
Shared razor with partner in past week	.186	(0, 1.639)	.05
Lifetime history of genital warts	3.94	(.628, Infinity)	.08
Washed genitals after sex	.235	(0, 1.476)	.08
Hours since had vaginal intercourse	.980	(.953, 1.000)	.03
Male partner's report of his own history and behaviors:			
More than 10 lifetime opposite-sex partners	.141	(.005, 1.249)	.05
Hours since had vaginal intercourse	.983	(.959, .999)	.02
Washed genital area after sex	.162	(0, .996)	.03

Note. Exact OR = exact odds ratio from SAS Proc Logistic.

95% Confidence Limits = mid-p confidence limits; mid-p significance tests have the possibility of attaining a two-tailed value less than .05 while the OR's exact 95% confidence interval (CI) includes 1 (see text).
p-value = mid p-value from conditional exact test.

LSIL/ASCUS = low grade squamous intraepithelial lesion or atypical squamous cells of undetermined significance detected on cervical cytology at the time of couple's HPV testing.