



Original Article

Clinical Outcome of Autoinoculation in the Management of Multiple Viral Warts: A Single-Arm Interventional Study

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ABSTRACT

Autoinoculation is a relatively inexpensive immunotherapeutic treatment for viral warts, which is claimed to trigger a specific immune response. **Objective:** To determine the clinical outcome of autoinoculation, in terms of complete, partial, or no response, among patients presented with multiple viral warts. **Methods:** This is a single-arm interventional (quasi-experimental) study, which recruited 60 patients with multiple viral warts through non-probability sampling between March to October 2025. Autoinoculation was done by excision, mincing, and implantation of a donor wart into a pocket made in the subcutaneous area. Follow-ups were made monthly following initiation of treatment, and outcome measured at 12 weeks in terms of complete, partial, or no response. SPSS version 25.0 was used to perform a statistical analysis. Chi-square tests and ordinal logistic regression were used to determine significant associations and to derive adjusted ORs. **Results:** Study results illustrate that 73.3% (n=44) of patients achieved a complete response, 15.0% (n=9) a partial response, and 11.7% (n=7) showed no response. Mean number of warts reduced significantly from 7.7 (pre-treatment) to 1.75 (post-treatment). Stratification analysis revealed a significant association of age with treatment outcome (p=0.031). Patients in the age group 15-30 years showed the highest rate of complete response. No other demographic or clinical factors demonstrated a significant association. **Conclusions:** Autoinoculation is a considerable practicing, safe and effective therapeutic modality in treating various viral warts. Its better results among young patients highlight the critical role of a strong immune system in the implementation of its therapeutic action.

INTRODUCTION

Warts, or verrucae, are benign epidermal lesions caused by the human papillomavirus (HPV), of which over 100 distinct types have been identified [1]. These common infections have a global prevalence of approximately 10%, a figure that rises significantly to 10-20% among school-aged children. Warts can manifest on any part of the body, including the hands, feet, face, and genitals, often leading to social embarrassment, fear of negative appraisal, and a substantially reduced quality of life for affected individuals [2]. This impact is reflected in healthcare-seeking behavior, with warts accounting for consultations in about

2% of adults and 6% of children [3]. Though clinical diagnosis is normally sufficient, some subtypes of warts require confirmation by laboratory studies like histopathology or immunohistochemistry [4, 5]. Several modalities, including salicylic acid, cryotherapy, electrocautery, surgical curettage, and laser therapy, have a wide range of therapeutic effects to deal with viral warts. The ablation of infected epidermal cells is the ultimate goal of most interventions [6]. Nonetheless, a notable drawback is that this local cytotoxicity often does not destroy the latent virus in the neighboring clinically



insignificant cells, and thus, it contributes to the development of therapeutic failure, recalcitrant lesions, and recurrent outbreaks [7, 8]. On the other hand, the use of autoinoculation has been suggested as an ideal modern form of managing multiple and recalcitrant warts. It is characterized by its effectiveness, low cost, less pain, non-invasiveness, and likelihood to heal without scarring compared to conventional treatments [9, 10].

Even though numerous treatment modalities are available, the treatment of warts is complicated, and no single method is universally effective. There is a need to evaluate the efficiency of various treatments, especially in individuals with multiple viral warts. Since autoinoculation is a simple procedure that does not require specialized or costly equipment, this study aimed to measure its impact among the local community in Karachi and explore its potential as a standard therapeutic option.

METHODS

This single-arm interventional (quasi-experimental) study was conducted during March 2025 to October 2025 at the Department of Dermatology of Tertiary Care Hospital, Malir Cantt, Karachi, following approval Institutional Ethical Review Board (IERB) via letter number: 143/2024/Trg/ERC issued on 30th December 2024. The sample size of 60 patients was determined using OpenEpi software, based on a 91.66% complete response rate reported by Ashraf et al., with a 95% confidence interval and 7% margin of error, employing a non-probability consecutive sampling technique. As a non-probability consecutive sampling technique has been used, selection bias can't be excluded [11]. Inclusion criteria encompass patients of either gender, aged 12-65 years, diagnosed with three or more viral warts. Viral warts were diagnosed clinically by the consultant dermatologist if there were benign hyperkeratotic lesions or thrombosed capillary dots caused by HPV on the face, neck, hands, feet, arms, or genitals. If the clinical diagnosis isn't clear, dermoscopy was performed. Exclusion criteria include patients currently or recently (within four weeks) treated for warts, those with an immunocompromised state (malignancies or chronic illness), pregnant or lactating mothers, and those unwilling to participate. All those patients who received immunotherapy within the last 12 weeks were also excluded. Informed consent was taken from all the patients before enrollment. Demographic data (age, marital status, education, job, residence) and clinical details (wart duration, number, size, site, signs/symptoms) were recorded. Wart size was measured using the measuring tape by two observers who were blinded to the study, and the mean of the two measurements was recorded to overcome the interobserver variability. Under local anesthesia and aseptic measures, autoinoculation was

performed. A feasible (easy to approach and excise) wart was selected as a donor wart from any part of the body, preferably the extremities. The volar surface of the forearm or the medial surface of the lower leg was selected as the recipient site, depending upon the preference of the patient. Both donor wart and recipient sites were cleaned with pyodine and local anesthesia (2% lignocaine). The selected warts were excised, cleared, and minced into very small fragments. A subcutaneous pocket was made on the recipient site (forearm or leg, both can be used for any type of warts), and the minced warts were inoculated. Then, the pocket was stitched with Prolene sutures (3.0/4,0). Sterile dressing was applied, and oral or topical prophylactic antibiotics were prescribed for five days to prevent secondary bacterial infection, with follow-ups at 4, 8, and 12 weeks. The procedure may be repeated up to three times for no or partial responses after 4 weeks of follow-up, targeting multiple sites (e.g., face/neck, palmoplantar). Outcomes were assessed at the 12th week after the 1st inoculation. Analysis was conducted using SPSS version 25, calculating means and standard deviations for quantitative variables (age, wart duration, size, number before/after treatment, autoinoculation) and frequencies/percentages for qualitative variables (gender, age groups, marital status, education, job, residence, wart signs/symptoms, site, outcome). Effect modifiers (gender, age, marital status, education, job, residence, wart size/duration/number/site, autoinoculation) were controlled via chi-square stratification, with $p \leq 0.05$ deemed significant. Ordinal logistic regression analysis was done to determine the adjusted odds ratios.

RESULTS

Out of the 60 patients studied, the average age was 38.57 years, with an even distribution between the 30-45 and 46-65 age groups (Table 1).

Table 1: Descriptive Statistics for Demographic Quantitative Variables

Variables (n=60)	Mean $\pm$ ST
Age	38.57 $\pm$ 13.54
Duration of Warts (Months)	17.72 $\pm$ 10.59
Number of Warts (Pre-Treatment)	7.70 $\pm$ 3.95
Number of Warts (Post-Treatment)	1.75 $\pm$ 3.49
Size of Warts (cm)	1.40 $\pm$ 0.62
Number of Inoculations	2.53 $\pm$ 0.50

The sample was slightly male-dominated (55%) and predominantly single (43.3%) in marital status. Education levels and job status were varied, with students comprising the largest occupational group (31.7%). Most patients were urban residents (53.3%) for over a year. The most common site for warts was the feet (25.0%). Before treatment, patients had an average 0%. Clinically, warts had been

present for an average of nearly 18 months, with the majority of patients (61.7%) having them for 7.70 warts, and the majority (63.3%) had more than five warts. The average wart size was 1.40 cm, with 65.0% of patients having warts larger than 1 cm. In terms of characteristics, most warts presented without small grainy growths (60.0%), a rough texture (55.0%), seeds (51.7%), or pain (56.7%) (Table 2).

Table 2: Descriptive Statistics for Clinical Qualitative Variables

Variables	Category	Frequency (%)
Gender	Male	33 (55.0%)
	Female	27 (45.0%)
Age Groups	15-30 years	16 (26.7%)
	31-45 years	22 (36.7%)
	46-65 years	22 (36.7%)
Marital Status	Single	26 (43.3%)
	Married	20 (33.3%)
	Widowed/Divorced	14 (23.3%)
Education	Illiterate	12 (20.0%)
	Primary	10 (16.7%)
	Matriculation	9 (15.0%)
	Intermediate	9 (15.0%)
	Graduate	8 (13.3%)
	Post-Graduate	12 (20.0%)
Job Status	Student	19 (31.7%)
	Unemployed	16 (26.7%)
	Housewife	15 (25.0%)
	Employed	10 (16.7%)
Residence	Urban	32 (53.3%)
	Rural	28 (46.7%)
Duration of Warts	<6 months	12 (20.0%)
	6-12 months	11 (18.3%)
	>12 months	37 (61.7%)
Site of Warts	Feet	15 (25.0%)
	Face & Neck	14 (23.3%)
	Arms	13 (21.7%)
	Hands	10 (16.7%)
	Genitals	8 (13.3%)
Small Grainy Growth	Yes	24 (40.0%)
	No	36 (60.0%)
Feeling Rough to Touch	Yes	27 (45.0%)
	No	33 (55.0%)
Wart Seeds	Yes	29 (48.3%)
	No	31 (51.7%)
Pain or Tenderness	Yes	26 (43.3%)
	No	34 (56.7%)
Number of Warts Group	≤5	22 (36.7%)
	>5	38 (63.3%)
Size of Warts Group	Up to 1 cm	21 (35.0%)
	>1 cm	39 (65.0%)

Pretreatment mean wart count was 7.70 ± 3.95 , which reduced to 1.75 ± 3.49 post-treatment. Paired t-test analysis reported that this difference was statistically

significant (p -value ≤ 0.05). The majority of patients, 44 (73.3%), achieved a complete response to autoinoculation treatment; 9 (15%) of patients experienced a partial response, which means overall efficacy was 53 (88.3%); while a minority, 7 (11.7%), showed no response to the treatment (Figure 1).

Outcome

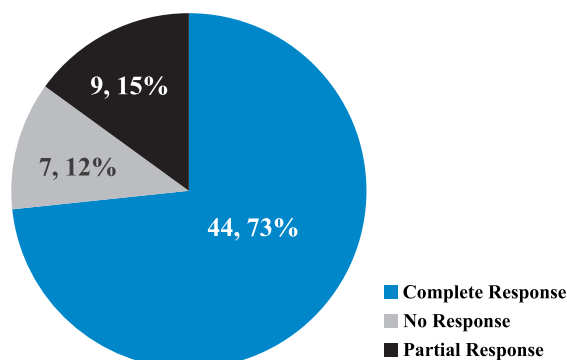


Figure 1: Distribution of Study Outcomes Among Total Study Population

The plantar warts before and after autoinoculation in one of the patients treated have been seen to have a visible reduction and healing of the lesion after the procedure (Figure 2).



Figure 2: Image Showing Autoinoculation Outcome Among Patients With Plantar Warts (A) Before Treatment (B) After Treatment

The before, after, and recovery images of the patients who underwent autoinoculation for plantar warts. These images show the evolution of the treatment and indicate the image of the lesion before the process, the instant post-process state, and the healing process in the recovery process, which is how the autoinoculation therapy was successful (Figure 3).



Figure 3: Image Showing Autoinoculation Outcome (A) Before Treatment (B) After Treatment (Resolution Phase) (C) Recovery

Of all the patient and clinical variables analyzed, only age demonstrated a statistically significant association with treatment outcome ($p=0.031$). Younger patients (15–30 years) showed the highest rate of complete response, whereas the 31–45 age group was disproportionately represented among those with no response to treatment (Table 3).

Table 3: Stratification Analysis of The Study Outcomes

Variables	Categories	Complete Response (n=44)	No Response (n=7)	Partial Response (n=9)	Chi-Square (p-value)
Gender	Male	25 (56.8%)	5 (71.4%)	3 (33.3%)	0.282
	Female	19 (43.2%)	2 (28.6%)	6 (66.7%)	
Age Groups	15–30	15 (34.1%)	0 (0.0%)	1 (11.1%)	0.031
	31–45	13 (29.5%)	6 (85.7%)	3 (33.3%)	
	46–65	16 (36.4%)	1 (14.3%)	5 (55.6%)	
Marital Status	Married	12 (27.3%)	4 (57.1%)	4 (44.4%)	0.267
	Single	21 (47.7%)	3 (42.9%)	2 (22.2%)	
	Widowed/Divorced	11 (25.0%)	0 (0.0%)	3 (33.3%)	
Education	Graduate	5 (11.4%)	1 (14.3%)	2 (22.2%)	0.326
	Illiterate	10 (22.7%)	2 (28.6%)	0 (0.0%)	
	Intermediate	5 (11.4%)	0 (0.0%)	4 (44.4%)	
	Matriculation	6 (13.6%)	2 (28.6%)	1 (11.1%)	
	Post-Graduate	10 (22.7%)	1 (14.3%)	1 (11.1%)	
	Primary	8 (18.2%)	1 (14.3%)	1 (11.1%)	
Job Status	Employed	6 (13.6%)	2 (28.6%)	2 (22.2%)	0.809
	Housewife	12 (27.3%)	1 (14.3%)	2 (22.2%)	
	Student	15 (34.1%)	1 (14.3%)	3 (33.3%)	
	Unemployed	11 (25.0%)	3 (42.9%)	2 (22.2%)	
Residence	Rural	22 (50.0%)	2 (28.6%)	4 (44.4%)	0.567
	Urban	22 (50.0%)	5 (71.4%)	5 (55.6%)	
Duration of Warts	<6 months	10 (22.7%)	1 (14.3%)	1 (11.1%)	0.392
	>12 months	27 (61.4%)	3 (42.9%)	7 (77.8%)	
	6–12 months	7 (15.9%)	3 (42.9%)	1 (11.1%)	
Site of Warts	Arms	9 (20.5%)	2 (28.6%)	2 (22.2%)	0.268
	Face & Neck	13 (29.5%)	0 (0.0%)	1 (11.1%)	
	Feet	10 (22.7%)	1 (14.3%)	4 (44.4%)	
	Genitals	5 (11.4%)	1 (14.3%)	2 (22.2%)	
	Hands	7 (15.9%)	3 (42.9%)	0 (0.0%)	
Number of Warts Group	≤5	19 (43.2%)	1 (14.3%)	2 (22.2%)	0.210
	>5	25 (56.8%)	6 (85.7%)	7 (77.8%)	
Size of Warts Group	Up to 1 cm	15 (34.1%)	3 (42.9%)	3 (33.3%)	0.897
	>1 cm	29 (65.9%)	4 (57.1%)	6 (66.7%)	

Several stratified comparisons were exploratory & no formal adjustment was made, which can increase the risk of type-I error. Ordinal logistic regression analysis showed that age in the range of 15 to 30 years ($AOR=0.002$; $p=0.008$), student status ($AOR=0.015$; $p=0.012$), and living in rural areas ($AOR=0.07$; $p=0.037$) were all significantly associated with complete treatment response, as found in the stratification analysis. No other factors, including gender, wart duration, location, number, or size, had a significant impact on the outcome (Table 4).

Table 4: Ordinal Logistic Regression Analysis of Factors Associated with Treatment Response

Variables	Categories	Adjusted OR	95% CI	p-value
Gender	Female VS Male	1.35	0.18 – 10.21	0.770
Age group (years)	15–30 VS 46–65	0.002	0.000 – 0.19	0.008
	31–45 VS 46–65	0.60	0.08 – 4.55	0.619
Marital status	Married VS Widowed/Divorced	4.87	0.20 – 121.5	0.335
	Single VS Widowed/Divorced	2.95	0.10 – 87.4	0.532
Education	Graduate VS Primary	17.25	0.30 – 987.4	0.168

	Illiterate VS Primary	0.56	0.01 – 45.9	0.797
	Intermediate VS Primary	8.25	0.31 – 219.4	0.207
	Matriculation VS Primary	0.56	0.02 – 17.1	0.739
	Post-graduate VS Primary	0.06	0.001 – 3.35	0.170
Job status	Employed VS Unemployed	2.42	0.15 – 38.5	0.532
	Housewife VS Unemployed	0.57	0.02 – 19.3	0.755
	Student VS Unemployed	0.015	0.001 – 0.40	0.012
Residence	Rural VS Urban	0.07	0.006 – 0.85	0.037
Monthly income	<30k VS 30k–60k	11.19	0.44 – 285.5	0.144
	>60k VS 30k–60k	0.05	0.002 – 1.28	0.070

Duration of warts	<6 months VS 6–12 months	0.15	0.006 – 4.17	0.267
	>12 months VS 6–12 months	0.06	0.003 – 1.13	0.060
Site of warts	Arms VS Hands	10.11	0.24 – 419.5	0.223
	Face & Neck VS Hands	0.02	0.0003 – 1.60	0.081
	Feet VS Hands	2.91	0.05 – 161.7	0.602
	Genitals VS Hands	0.99	0.02 – 47.4	0.995

DISCUSSION

The present study evaluated the efficacy of autoinoculation therapy in patients with multiple viral warts, demonstrating a complete response in 73.3% of cases, a partial response in 15.0%, and no response in 11.7%. The current findings highlight the usefulness of autoinoculation as a highly potent modality in the management of warts, especially in patients who initially present with multiple lesions as well as recalcitrant lesions. The average number of wart burden per patient was significantly decreased after treatment, and most patients only needed two or three inoculations. Notably, there were no clinically significant procedure-related complications reported, and the treatment was well tolerated. Our response rates are in line with the already published studies. Ashraf *et al.* (91.6% complete response rate) articulated a significantly greater rate of clearance in their group compared to Shahid *et al.* (77.1% clearance rate) and agreement with our results [11, 12]. On the same note, Das *et al.* reported a complete clearance rate of 69.5% in their study of 83 patients, which also confirms the effectiveness of this modality [13]. In a randomized controlled trial, Lal *et al.* reported a complete resolution in 62.5% of auto-inoculated patients; it was indicated that this method was better than placebo [14]. However, the present study should be compared with randomized trials with caution because it is a single-arm, non-controlled trial. The therapeutic potential of autoinoculation is supported by recent evidence from Barnwal *et al.* (63.3% complete clearance) and Taneja *et al.* (67% resolution), especially in multiple and recalcitrant lesions [15, 16]. Further research by Narayanan *et al.* on anogenital warts, Swaroop *et al.* with a modified implantation technique, and Chhangte *et al.* in a cohort of patients in North-Eastern India all reported a clearance rate of between 60 and 75 percent, further indicating the reproducibility of the results of the research across the various patient populations and clinical settings [17–19]. These congruent findings indicate that autoinoculation is a minimally invasive and cost-effective method with an effectiveness rate that ranges consistently over 60 percent and, in some cases, up to 90 percent, supporting its presence as a promising therapeutic standard in various viral warts. Above all, it's a safe procedure, as not a single patient reported a significant side effect or secondary infection on follow-up visits. The multivariate ordinal regression analysis indicated that

younger age is a strong predictor of a poor treatment response when adjusted for possible confounders. Additionally, rural residence and student status turned out to be variables that were linked with the increased possibility of a positive outcome. These data indicate that, in addition to immunological factors, sociodemographic factors are also likely to play a role in determining the efficacy of the therapeutic process. Among the clinical and demographic characteristics studied, age was the only variable that was found to have a significant treatment outcome [19]. The highest complete response rates were seen in patients aged 15 to 30 years, and the proportion of non-responders was overrepresented in the 31 to 45-year age bracket. This tendency can be attributed to the fact that younger people have a stronger immune system to resist the infection, which confirms the assumption that immunological competence is one of the primary factors influencing treatment outcomes. Other factors, such as gender, length of warts, size, number, location, education, and house, had no statistically significant influence, which supports the previous argument that host immunity has a more critical influence than demographic or socioeconomic factors [20]. Most of the warts were on the feet, then on the face/neck, and the arms, and this is in line with areas that are usually exposed to trauma or infection. Also, the majority of patients were reported with several warts bigger than 1cm, and this reiterates the recalcitrancy of the disease. Positively, autoinoculation has produced desirable results with these hard-to-treat properties.

The research has a number of strengths, such as a clear methodology, standard outcome measurement, and extensive clinical and demographic stratification. However, limitations should be acknowledged. Although the sample size was sufficient in the context of descriptive analysis, it was relatively small and restricted to one center, which could have impacted the generalizability. Another important limitation is the use of a non-probability consecutive sampling technique for enrollment of patients, which can cause potential selection bias. Furthermore, large confidence intervals and large odds ratios indicate instability of the model as the sample is small, and the outcome distribution is sparse. In addition, the period of follow-up was limited to three months after treatment, which ruled out the possibility of assessing the recurrence in the long term. The findings should be justified by future studies using large and multicenter cohorts with long follow-ups. Last but not least, the lack of a comparator arm makes it impossible to directly compare the efficacy of the treatment with other therapies.

CONCLUSIONS

Autoinoculation proved to be a promising and effective intervention in managing the multiple viral warts due to its

cost-effectiveness, low invasiveness, and better outcome profile, which is especially beneficial in resource-limited settings. However, first-line use should be recommended only after comparative controlled studies. The current study highlights a major role of patient age in determining therapeutic effects, hence the critical role of host immunity in mediating clinical response. Additional research using larger, multicenter, controlled comparative trials with longer follow-up is necessary to support these promising results and strengthen the role of this procedure as one of the standards of care in the dermatological practice.

Authors' Contribution

Conceptualization: NUH, SK

Methodology: NUH, SK, GY

Formal analysis: NUH, NH, IA, TH

Writing and Drafting: NUH, SK, NH

Review and Editing: NUH, SK, NH, IA, GY, TH

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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