

Quality of Life Assessment and Related Factors of HIV-Infected Patients in Hangzhou Using a Path Analysis Model: An Observational Study

Hao-yu Xing¹, Juan Yan²

¹Medical Engineering Department, Hangzhou Seventh People's Hospital, Hangzhou, 310013, People's Republic of China; ²Medical Affairs Department, Hangzhou Seventh People's Hospital, Hangzhou, 310013, People's Republic of China

Correspondence: Juan Yan, Medical Affairs Department, Hangzhou Seventh People's Hospital, No. 305, Tianmushan Road, Xihu District, Hangzhou, 310013, People's Republic of China, Email yanjuan2022@126.com

Objective: This study aimed to examine which path among direct and indirect effects was more influential to the quality of life (QOL) for patients with human immunodeficiency virus (HIV).

Methods: An observational study among 951 individuals diagnosed with HIV was conducted in designated acquired immunodeficiency syndrome (AIDS) medical institutions in Hangzhou using simple random sampling technique. We collected the demographic data of patients and then evaluated their QOL by 12-Item Short-Form (SF-12) questionnaire survey. The two-stage least squares analysis was firstly performed to filter the independent influencing factors of Physical Component Summary (PCS) and Mental Component Summary (MCS). We then enrolled the PCS, MCS, and their influencing factors into the path analysis of QOL, and further revealed the direct and indirect effects of variables and examined the important path that was more influential on the patient's QOL.

Results: The patient's PCS, MCS, and quality of life showed a significant difference between groups in terms of education level and working condition (all $P < 0.05$). Regression analysis showed that depression, age, education level, and treatment independently affected the PCS (all $P < 0.05$), and depression and anxiety exerted an independent effect on the MCS (all $P < 0.05$). Further path analysis integrating related variables showed that the main indexes of the goodness of fit implied the final model fit the data well. The path analysis showed that PCS and MCS exerted direct effects on the QOL (all $P < 0.001$), especially the MCS ($\beta = 0.785$), but other variables exerted no direct effects (all $\beta = 0$, all $P > 0.05$). It should be noted that anxiety presented an obvious indirect effect on the QOL ($\beta = 0.460$), and its indirect effect was similar to the direct effect of PCS ($\beta = 0.471$).

Conclusion: The MCS might exert a more important effect on the QOL of HIV patients. In addition, the indirect effect of anxiety on the QOL should not be ignored.

Keywords: HIV, quality of life, path analysis, effects

Introduction

Human immunodeficiency virus (HIV) infection has become a major global threat to public health and significantly influenced social development. As of September 30, 2016, 653,865 people was reported to live with HIV in China.¹ By the end of 2019, 38.0 million people live with HIV globally and approximately 1 million people were known to be living with HIV in China.² Due to the particularity of HIV, the patients with HIV always faced many social problems, such as difficulties in finding employment, dating obstacles, prejudice associated with sexual orientation,³ which have serious effects on their quality of life (QOL). HIV patients generally show a high incidence of mental health problems, bear huge psychological pressure,⁴⁻⁶ and presented stigmatizing attitudes.^{7,8} HIV is more often a chronic manageable disease rather than a terminal illness. Consequently, the focus of HIV care has been shifting from increasing life expectancy to the improving QOL.

The QOL is a comprehensive and dynamic index, mainly a subjective feeling index, and it is established under a certain cultural value system. In terms of recent events, Naghizadeh et al reported a reverse correlation between fears of

COVID-19 and QOL.⁹ The patient's QOL is closely related to various factors such as the intent to leave,¹⁰ stress, marital relationship,¹¹ psychosocial processes,¹² provider communication behaviors,¹³ and care burden.¹⁴ For HIV patients, Liu et al's study found that the sexual orientation was closely related to the QOL of HIV patients in China, and a better QOL was found for homosexual individuals (34028639). Huang et al's study indicated that QOL of HIV patients was relatively lower after HIV diagnosis and presented an increase 1 year after HIV diagnosis.¹⁵ A precise evaluation on the QOL of HIV patients was not only conducive to improve the life quality of patients but also was necessary to assess the intervention outcomes.¹⁶

Although previous studies have reported the risk factors affecting the QOL of HIV-infected patients,^{17,18} few studies revealed the hierarchy among several risk factors. In addition, the QOL of HIV patients in Hangzhou has not been revealed, which was unfavorable for making management program and improving the QOL of HIV patients. In this study, we performed the path analysis to examine which path among direct and indirect effects was more influential on the QOL of patients. We disclosed the disease pattern of HIV in Hangzhou and the results from this study provided a reference value for performing interventions and improving the quality of life of HIV patients.

Methods

Study Setting and Period

This observational study was performed between January 2019 and January 2022. The required data were collected from HIV patients receiving antiretroviral therapy in designated AIDS medical institutions in Hangzhou, Zhejiang Province. The ethical approval was obtained from the Institutional Review Board at the researchers' institution (NO. HZ07/2019H23) and designated AIDS medical institutions (NO. ZJHZ-MH/0983). This study complies with the Declaration of Helsinki. After receiving informed consent from patients, a structured questionnaire was used to collect data.

Sampling

This study was conducted on total patients with HIV. The study participants were screened using the simple random sampling technique based on the order of admission. All the HIV patients visited designated AIDS medical institutions for medical examination and treatment services. During this time, the patients were approached by a researcher to assess having inclusion criteria, explaining study objective, and providing informed consent form. Written consent form was obtained from those agreed to participate in the study.

Inclusion and Exclusion Criteria

The inclusion criteria of patients included 1) diagnosis of infection of HIV, being in clinical follow-up in the Specialized Care Service in HIV; 2) age ≥ 18 years, of both genders; 3) HIV positive confirmed by Western blotting (WB); and 4) no cognitive impairment. The exclusion criteria included the following: 1) patients with other serious physical diseases, such as severe liver and kidney dysfunction, malignant tumor, etc; 2) patients showed major mental disorders: schizophrenia, dementia, mental retardation, manic episode, etc. During the data collection period, a total of 1053 people met the inclusion criteria, 987 people participated in the study, and 951 valid questionnaires were obtained, with an effective response rate of 96.35%.

Questionnaire Survey

Under the principle of voluntary participation, the questionnaire survey was conducted when the patients signed informed consent. For the study participants who can understand the questionnaire, they complete the questionnaire by themselves under the guidance of the investigator. The samples are unable to fill in the questionnaire by themselves due to their low educational level, the investigators will ask them and help them complete the questionnaire. Firstly, the self-compiled general condition questionnaire was used to collect the basic information of patients including age, gender, working status, occupation, educational level, medical residence status, marital status, time of diagnosis, duration from the first treatment, and antiviral therapy.

The life quality of patients was then evaluated by the 12-Item Short-Form (SF-12) Scale TM. The SF-12 Scale TM is a simplified version derived from the MOS Item Short from Health Survey (SF-36) developed by the Institute of Health Education in Boston, USA.¹⁹ It has been reported that the resulting SF-12 has been found to explain around 90% of the variance in PCS-36 and MCS-36 scores.^{20,21} The SF-12 includes 12 items involving 8 dimensions, namely physical function (PF), role physical (RP), bodily pain (BP), general health (GH), vitality (VT), social function (SF), role emotional (RE) and mental health (MH). A higher score indicates a better subjective feeling. The PF, RP, BP, and GH can be used to calculate the Physical Component Summary (PCS), and VT, SF, RE, and MH can be used to assess the Mental Component Summary (MCS).

Regression Analysis on the PCS, MCS, and Life Quality by Two-Stage Least Squares Analysis

Because the PCS and MCS were closely related to the life quality of patients, we firstly evaluated the influencing factors of PCS and MCS. We performed the two-stage least squares analysis to filter the influencing factors of PCS and MCS, respectively. The variables enrolled in the two-stage least squares analysis included age, gender, working status, occupation, educational level, medical residence status, marital status, time of diagnosis, duration from the first treatment, and antiviral therapy. For the life quality assessment, we also enrolled the PCS and MCS besides the above variables.

Path Analysis on the Life Quality of Patients

We subsequently performed the path analysis to assess the potential effects of several variables on the life quality of patients. Path analysis can be used to examine whether the path model was acceptable and to examine which path among direct and indirect effects was more influential on life quality. Regarding the path analysis, life quality was set as the dependent variable, and PCS, MCS, and their influencing factors were selected as the independent variables. Indicators such as P , χ^2/df , Goodness-of-Fit Index (GFI), Root-Mean-Square Error of Approximation (RMSEA), and Normed Fit Index (NFI) were used to assess the degree of fitting of our predicted model equation. The standardized coefficients were used to compare the effects of an independent variable on the dependent variable. In the practice process, the path model needed to be improved continuously until the final model fit the data well. For the path analysis, $P < 0.05$ was considered a significant term.

Statistical Treatment

The data were analyzed by SPSS 23.0 software. Continuous variables were expressed as mean \pm standard deviation (M \pm SD). The difference in life quality, PCS, and MCS between groups was compared with an independent t -test or one-way ANOVA. The factors affecting PCS, MCS, and life quality were filtered by a two-stage least squares analysis. The pathway analysis was performed to examine which pathway among direct and indirect effects was more influential on the life quality. $P < 0.05$ was considered a statistical significance.

Results

The Comparison of QOL, PCS, and MCS Scores Based on the Patient's Demographic Characteristics

A total of 951 patients with HIV were enrolled in this study. The median duration of disease was 2.28 years ranging from 1.16 to 3.78. Of the 951 patients living with HIV, nearly half were located in the 20–29 years old group. The education level of approximately two-thirds of individuals was at least college. The demographic characteristics of HIV patients are presented in Table 1.

The life quality score showed statistical significance between groups based on education level ($P < 0.001$) and working conditions ($P < 0.001$). The PCS presented differences between groups in terms of age ($P = 0.014$), an education level ($P < 0.001$), working conditions ($P < 0.001$), and treatment methods ($P = 0.018$). The MCS indicated the difference between groups regarding education level ($P < 0.001$) and working conditions ($P < 0.001$). It followed that education level and working conditions were the most important factors affecting life quality score, PCS, and MCS of patients.

Table 1 The Comparison of QOL, PCS, and MCS Scores (Means±SD)

		QOL	PCS	MCS
Gender				
Male	914 (96.11%)	99.08±12.16	52.38 ±6.11	46.70±10.09
Female	37 (3.89%)	100.09±13.39	52.90 ±5.55	47.19±11.26
		$t=-0.495, P=0.621$	$t=-0.504, P=0.615$	$t=-0.291, P=0.771$
Age (years)				
≤19	10 (1.1%)	96.91±11.04	54.56±5.24	42.34±10.66
20–29	421 (44.3%)	99.73±11.25	52.94±5.33	46.79±9.71
30–39	380 (40.0%)	98.56±12.85	52.25±6.38	46.27±10.58
40–49	113 (11.9%)	99.67±13.30	50.86±7.06	48.80±9.93
≥50	27 (2.8%)	96.22±12.46	51.66±7.53	44.56±9.76
		$F=1.003, P=0.405$	$F=3.140, P=0.014$	$F=2.161, P=0.071$
Education level				
Primary school	11 (1.2%)	98.5155±17.21324	51.4964±6.53104	46.9945±13.39695
Middle school	305 (32.1%)	96.6271±12.70162	51.2328±6.80802	45.3943±10.27895
College or above	635 (66.7%)	100.3504±11.67454	52.9939±5.608	47.3621±9.94905
		$F=9.848, P<0.001$	$F=8.954, P<0.001$	$F=3.939, P<0.001$
Marital status				
Unmarried	665 (69.9%)	98.95±12.12	52.57±5.75	46.39±10.11
Married	188 (19.8%)	100.34±12.75	52.19±7.09	48.14±10.47
Divorced or widowed	98 (10.3%)	97.73±11.51	51.58±6.19	46.14±9.30
		$F=1.603, P=0.202$	$F=1.208, P=0.299$	$F=2.382, P=0.093$
Working conditions				
Employed	781 (82.1%)	100.01±11.55	52.69±5.83	47.32±9.75
Retired	14 (1.5%)	92.84±12.68	46.80±6.92	46.04±11.21
Unemployed	156 (16.4%)	94.74±14.39	51.33±6.97	43.43±11.41
		$F=13.515, P<0.001$	$F=0.923, P<0.001$	$F=9.101, P<0.001$
Treatment methods				
Antiviral therapy	947 (99.6%)	99.15±12.19	52.43±6.06	46.73±10.13
Else	4 (0.4%)	85.95±7.20	44.10±6.57	41.84±7.45
		$t=1.875, P=0.061$	$t=2.372, P=0.018$	$t=0.834, P=0.405$

The Regression Analysis of the PCS and MCS by Two-Stage Least Squares Analysis

As the PCS and MCS, all affected the life quality of patients. Therefore, we firstly explored the influencing factors of PCS and MCS by two-stage least squares analysis. The PCS of patients can be influenced by a combination of age, gender, education level, marital status, working conditions, treatment methods, disease duration, interval since the first treatment time, depression score, and anxiety score. Hence, we performed the regression analysis on PCS to effectively control the confounding factors. The regression model showed statistical significance ($F=14.788, P<0.001, R^2=0.148$), and the model coefficients based on the PCS as a dependent variable are shown in Table 2.

The regression analysis in Table 2 showed that depression score, age, and treatment were the negative elements affecting the patient's PCS, while education level was a positive factor. According to the standardized coefficients, the influence of depression score on the patient's PCS was largely greater than other variables.

Similar to PCS, we also performed the line regression analysis to effectively control the confounding factors regarding the MCS. The regression model showed statistical significance ($F=67.321, P<0.001, R^2=0.441$), and the model coefficients regarding the MCS as a dependent variable were shown in Table 3. The regression analysis showed that depression scores and anxiety scores were the negative factors for MCS. According to the standardized coefficients, there was not much difference in the influence of depression score and anxiety score for the patient's MCS.

Table 2 The Regression Model About the PCS

Variables	Unstandardized Coefficients		Standardized Beta	t-value	P
	Beta	Std. Error			
Constant	60.479	3.812		17.061	<0.001
Depression score	-0.326	0.064	-0.269	-5.097	<0.001
Age	-0.918	0.287	-0.12	-3.201	0.001
Education level	0.928	0.4	0.076	2.32	0.021
Treatment	-7.273	3.286	-0.067	-2.213	0.027

Table 3 The Regression Model About the MCS

Variables	Unstandardized Coefficients		Standardized Beta	t-value	p
	Beta	Std. Error			
Constant	56.624	5.139		11.018	<0.001
Depression score	-0.751	0.086	-0.372	-8.710	<0.001
Anxiety score	-0.737	0.101	-0.311	-7.296	<0.001

Abbreviation: MCS, Mental Component Summary.

Table 4 Model Fit for Pathway Analysis of Life Quality Score

Index	χ^2	df	P	χ^2/df	GFI	RMSEA	NFI
Good Criterion	–	–	>0.005	<3	>0.9	<0.10	>0.9
Effect	44.233	16	0.021	2.764	0.995	0.068	0.996
Decision			Accept	Accept	Accept	Accept	Accept

Abbreviations: GFI, Goodness-of-Fit Index; RMSEA, Root-Mean-Square Error of Approximation; NFI, Normed Fit Index.

The Path Analysis of the QOL

We also performed the regression analysis on the life quality score. Besides the above variables, the PCS and MCS were also enrolled. Regression analysis results just showed the statistical significance of PCS and MCS on the patient's life quality score. The above analysis has indicated that several variables affected the PCS or MCS, but not independently influenced the patient's life quality score. It followed that there was a hierarchy of parameters. Therefore, we performed a path analysis on the life quality score by enrolling the PCS, MCS, and their influencing factors.

The index of model fit for the pathway analysis is presented in [Table 4](#). The $P=0.021$, $\chi^2/df=2.764$, $GFI=0.995$, $RMSEA=0.068$. All the indexes referred to the accepted condition. The main indexes of the goodness of fit implied the final model fit the data well. It should be noted that we also evaluated the path of depression score, age, education level, treatment, depression score, and anxiety score to life quality. We found no direct influence of these variables on life quality as all standardized coefficients=0 and all the P-values >0.05. Therefore, we excluded the path of these variables to life quality in our final pathway model ([Figure 1](#)).

[Table 5](#) lists the standardized estimates of the pathological patterns. As can be seen, all standardized coefficients have a significant relationship with the dependent variable. The results of path analysis showed that depression score, age, and no antiviral therapy negatively affected the PCS, and education level positively influenced the PCS (all $P<0.05$). These four variables exerted direct effects on the patient's PCS. The depression score and anxiety score presented a direct and negative impact on the MCS of patients (all $P<0.001$). Further, PCS and MCS showed a direct and positive impact on the life quality of patients (all $P<0.001$). The highest estimate for the standardized regression weight was found in the path from the MCS to life quality (Standardized $\beta=0.785$).

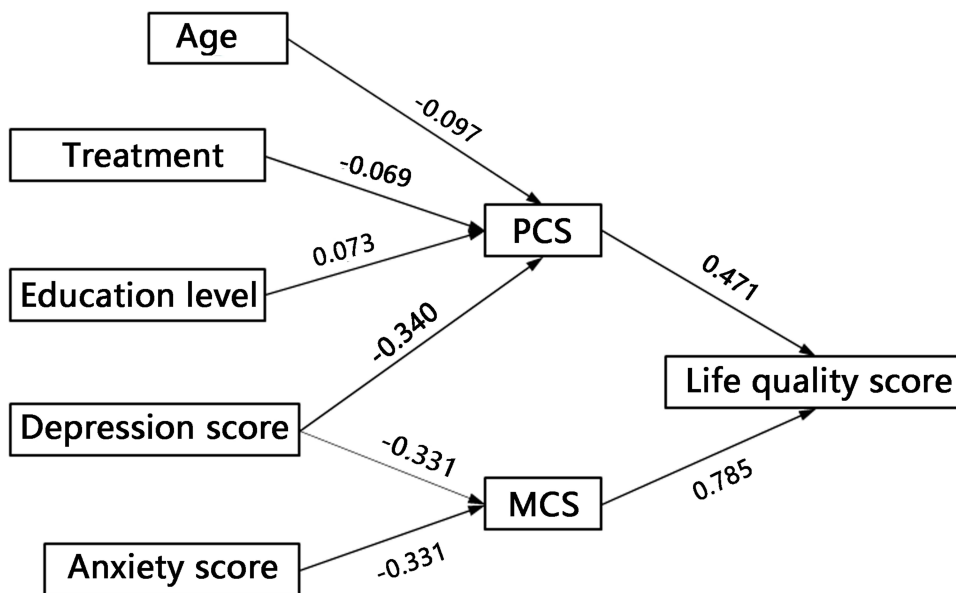


Figure 1 Results of path analysis on the quality of life. The model provided a good fit when the PCS, MCS, and their influencing factors were enrolled (GFI=0.995, RMSEA=0.068, NFI=0.996).

Table 6 lists the direct, indirect, and total effects of the pathological patterns. The direct pathway coefficient=standardized regression coefficient. The indirect pathway coefficient of X on Y1 through Y1=the direct pathway coefficient × correlation coefficient between X and Y1. The total path coefficient=direct path coefficient + indirect path coefficient. The results showed that the PCS (beta=0.471) and MCS (beta=0.785) showed a significant direct effect on the life quality of patients. The age, treatment, education level, depression score, and anxiety score had only indirect effects on the life quality of patients. The highest total effects on life quality were referred to MCS. In addition, the anxiety score exerted obvious indirect effects (beta=0.460) on the life quality by affecting MCS.

Table 5 The Coefficient of the Path Analysis Regarding Influencing Factor of Quality Life Score

Independent	→	Dependent	Standardized Coefficients	Std. Error	P
Depression score	→	PCS	-0.340	0.037	<0.001
Age	→	PCS	-0.097	0.240	0.002
Education level	→	PCS	0.073	0.382	0.020
Treatment	→	PCS	-0.069	3.267	0.022
Depression score	→	MCS	-0.381	0.085	<0.001
Anxiety score	→	MCS	-0.311	0.100	<0.001
PCS	→	Life quality score	0.471	0.001	<0.001
MCS	→	Life quality score	0.785	0.000	<0.001

Table 6 Results of the Total, Direct, and Indirect Effects Regarding Life Quality as the Dependent Variable

Influencing Factors	Direct	Indirect	Total Effect	Ranking
PCS	0.471	0	0.471	2
MCS	0.785	0	0.785	1
Age	0	-0.041	-0.041	6
Treatment	0	-0.032	-0.032	7
Education level	0	0.059	0.059	5
Depression score	0	-0.386	-0.386	4
Anxiety score	0	0.460	0.460	3

Discussion

With the change in the medical model and the improvement of living standards, the patients especially those with chronic diseases pay more and more attention to their social and psychological state and put forward higher requirements for their quality of life. Therefore, the quality of life can be used to reflect the health status of the individuals. As a special group of chronic diseases, the quality of life of HIV patients is valued highly by modern society. The results of this study showed that the physical and mental health scores of HIV patients were unfavorable. It is extremely important to strengthen the treatment and care for HIV patients to improve their quality of life.²²

In this study, we found a significant difference in PCS, MCS, and life quality based on education level and working conditions. Those with higher education levels have a higher quality of life, suggesting that higher education levels can not only help them acquire more knowledge of HIV treatment and health care but also influence their quality of life in other ways. The results were consistent with the findings of a previous study.²³ However, we did not observe its direct effect on the quality of life by path analysis. The education level plays an important role in obtaining economic sources, and the level of education affects the level of economic income to a certain extent. In addition, HIV patients with a high education level are often able to obtain a stable job providing a good economic resource, thus providing a guarantee in terms of living conditions.²⁴ Their psychological adjustment ability and social adaptation coordination ability are better, which can help them to obtain more medical resources, better treatment, and care.²⁵ Working condition is an important factor affecting the life quality of patients.²⁶ Work can improve the patient's self-worth and provide more social relationships and sources of social support.^{27,28} It followed that work not only enables HIV patients to maintain a good living standard but also can build their life confidence, establish an optimistic attitude towards life, which exerts a promoting effect on both physical and psychological aspects.

We also performed path analysis to examine which path among direct and indirect effects was more influential on the life quality. Before path analysis, we initially explored the related factors associated with PCS and MCS by two-stage least squares analysis. Hikasa et al have shown that older age was independently related to lower PCS,²⁹ and the same result was also confirmed in our study. Sabranski et al found that depression was significantly related to a lower PCS.³⁰ In this study, we also found the independent influence of depression on the patient's PCS. For the MCS, we only observed the independent role of depression and anxiety. Valdelamar-Jiménez et al have shown that MCS had high negative correlation with depression inventory.³¹ Dutra et al indicated that sex and stable relationship were good predictors of MCS in HIV-infected patients.³² Based on the results of the two-stage least squares analysis, we enrolled the PCS, MCS, and their influencing factors into the path analysis on life quality. And MCS showed the most obvious direct impact on the quality of life of HIV patients. Tomioka et al³³ assessed the quality of life of community-dwelling older people, finding that the mental component can independently predict the incident functional disability of these persons. Ding et al indicated that MCS from health-related quality of life predicts the incidence of dementia.³⁴ In addition, anxiety and depression exerted an obvious indirect effect on the life quality by influencing the MCS of patients. Betancur et al reported that related assessment about psychological conditions from anxiety and depression aspects was necessary throughout therapy, which was strongly linked to the patient compliance, treatment efficiency, and ultimately to patients' quality of life.³⁵

Finally, this study must acknowledge several limitations. The study just enrolled the patients of designated AIDS medical institutions in Hangzhou, Zhejiang. It is better if the multicenter survey involving more institutions in China was implemented. In addition, most of participants in this study were men who have sex with another men (MSM). The quality of life of MSM were found to be lower than those of general residents. Our study did not investigate the impact of MSM on the QOL of HIV patients, which might be a valuable point in the future study. Despite these inadequacies, our study provided precious reference value in assessing the QOL of HIV patients in Hangzhou. Several studies have assessed the QOL of HIV patients in China, but no research focused on Hangzhou region presently. This study firstly disclosed the disease pattern of HIV patients in Hangzhou.

Conclusion

This study reported that the quality of life, PCS, and MCS showed a significant difference between different education levels and working conditions. Depression, age, education level, and antiviral treatment independently affected the PCS

of HIV patients. Only depression and anxiety showed independent impacts on the patient's MCS. Path analysis containing MCS, PCS, and their influencing factors showed that PCS and MCS had obvious direct effects on the patient's quality of life, especially the MCS, but other variables showed no direct effects. It should be noted that depression and anxiety exerted significant indirect effects on the patient's quality of life by affecting MCS. Our results suggested that mental health might exert a more important effect on the life quality of HIV patients. These results remind us that we should pay more attention to the mental health of patients by providing effective psychology guidance, forming a powerful social support network, and actively promoting health education and psychological consultation. In addition, it is necessary for the HIV patients to create a tolerant social environment, oppose social discrimination, and mobilize family and community participation.

Data Sharing Statement

The dataset used and/or analyzed during the current study is available from the corresponding author on reasonable request.

Ethics Statement

This study was approved by the Ethics Committee of Hangzhou Seventh People's Hospital and written informed consent has been provided by the patient. Our study complies with the Declaration of Helsinki.

Consent for Publication

For this manuscript containing any individual person's data in any form (including individual details, images or videos), we have obtained the consent to publish from that person.

Disclosure

The authors declare that they have no conflicts of interest.

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