# *Functional outcomes of Fournier's gangrene: a multi-institutional experience*

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***Introduction:*** *Fournier's gangrene (FG), is a progressive, necrotizing soft tissue infection of the external genitalia, perineum, and/or anorectal region. How treatment and recovery from FG impacts quality of life related to sexual and general health is poorly characterized. Our purpose is to evaluate the long term impact of FG on overall and sexual quality of life using standardized questionnaires through a multi-institutional observational study.*

***Materials and methods:*** *Multi-institutional retrospective data were collected by standardized questionnaires on patient-reported outcome measures including the Changes in Sexual Functioning Questionnaire (CSFQ) and the Veterans RAND 36 (VR-36) survey of general health-related quality of life. Data were collected via telephone call, email, and certified mail, with a 10% response rate. There was no incentive for patient participation.*

***Results:*** *Thirty-five patients responded to the survey, with 9 female and 26 male patients. All patients in the study underwent surgical debridement between 2007-2018 at three tertiary care centers. Further reconstructions were performed for 57% of respondents. Values for respondents with overall lower sexual function were reduced in all component categories (pleasure, desire/frequency, desire/interest, arousal/excitement, orgasm/completion), and trended toward male sex, older age, longer time from initial debridement to reconstruction, and poorer self-reported general health-related quality of life metrics.*

***Conclusion:*** *FG is associated with high morbidity and significant decreases in quality of life across general and sexual functional domains.*

**Key Words:** Fournier's gangrene, reconstructive surgery, functional quality of life, CSFQ, VR-36

## Introduction

Fournier's gangrene (FG) is a progressive, necrotizing soft tissue infection of the external genitalia, perineum, and/or anorectal region.[1] Expedited recognition, initiation of broad-spectrum antibiotics, and aggressive surgical debridement is critical in its management. Unfortunately, despite prompt diagnosis and management, mortality rates remain high.[2,3]

The etiology of FG is often polymicrobial, with common risk factors including diabetes mellitus, hypertension, and HIV infection. FG typically affects individuals in their fifth or sixth decade of life[4-7] and is more common in men.[8,9] Extensive surgical debridement is the cornerstone of surgical management of FG.[10]

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How treatment and recovery from FG impacts quality of life related to sexual and general health is poorly characterized, perhaps due in part to the small number of affected patients. Our hypothesis is that FG patients have worse quality of life related to sexual and general health. To assess our hypothesis, we employed retrospective surveys of FG patients across three academic healthcare centers, and we gathered standardized patient-reported outcome measures (PROM) on overall and sexual quality of life after surgical intervention for FG. Our goal was to better characterize long term outcomes in this patient population, thus informing future efforts to improve long term sexual and general health quality of life following treatment of and recovery from Fournier's Gangrene.

## Materials and methods

### *Study population*

This was a multi-institutional retrospective study of patients who underwent surgical debridement as management for their FG from 2007-2018 at three academic tertiary care centers. ICD-9/ICD-10 and Current Procedural Terminology (CPT) codes were used to identify patients with a diagnosis of FG, genital and perineal necrotizing fasciitis and/or treatment including debridement and reconstruction of the scrotum, genitalia, or perineum. To determine quality of life related to sexual and general health following FG, patients were contacted and completed the consent process and questionnaires with a research associate over the telephone, email, or certified mail, with a 10% response rate. Demographic variables of interest (i.e., patient age, sex, race) and clinical variables (e.g., admission complete blood cell count (CBC), admission chemistries, and temperature on admission), were collected via chart review, while survey data were collected directly from patients. There was no incentive for patient participation. Study approval was granted by each institution's Institutional Review Board [2018H0183].

### *Instruments*

The Changes in Sexual Functioning Questionnaire (CSFQ, clinical version) is a structured questionnaire designed to evaluate changes in sexual functioning based on illness or medication therapy. The CSFQ evaluates sexual function in five domains (pleasure, desire/frequency, desire/interest, arousal/excitement, orgasm/completion), via 14 items rated based on a five-point Likert-type scale (1 indicates never/no enjoyment and 5 indicates every day/great enjoyment).[11] Higher scores correlate with better sexual functioning.[12] Studies have demonstrated the ability of the CSFQ to measure changes in sexual function.[12,13] Demographic characteristics used to develop this questionnaire were separated based on gender. The mean age among individuals used in CSFQ survey development was 41.3 (SD 11.3), and the study population was predominately white (93.5%) and married (69.5%).[11]

The Veterans RAND 36 Item Health Survey (VR-36) is a widely used health-related quality of life assessment tool comprised of 36 questions designed to evaluate 8 health domains, including bodily pain, physical functioning, and the impact of their disease burden on social functioning and mental health.[14] Studies have demonstrated the VR-36's ability to measure changes in quality-of-life.[15,16] Demographic characteristics used to develop this questionnaire were separated based on gender. The study population was only comprised of adults (≥ 18 years of age), with 90% being ≥ 65 years, predominantly white (81%) and married (72%).[17]

FG Severity index (FGSI), described by Laor et al, provides an aggregate score of FG severity based on creatinine, hematocrit, potassium, white blood cell count, sodium, serum bicarb, temperature, heart rate, and respiratory rate.[18] Each variable is assigned a value of 0-4 based on deviation from ordinary values, and component scores are combined to create the FGSI score.

The goal of our study is to demonstrate how FG impacts patient healthcare-related quality of life (HRQoL) and sexual functioning. We compared FG survey responses to averages or cutoffs established from survey development given the demographic factors noted above. Although our FG patient cohort may differ from the general population, for example, due to additional demographic and clinical characteristics that predispose individuals to FG (e.g., diabetes mellitus (DM), obesity, age), these comparisons to the general population averages are intended to reflect the aggregate differences among our patients inclusive of their FG diagnosis and other demographic factors. Unfortunately, many risk factors for FG remain prominent in the general US population: e.g., 41.9% adult obesity, and 11.3% rate of DM.[19-21] Although our study is comprised of adult patients, FG has been observed in pediatric and adolescent patients.[22]

### *Statistical analysis:*

Demographic and quality of life characteristics were summarized across survey respondents using descriptive statistics (median and interquartile

TABLE 1. **Demographic and clinical attributes (n = 35)**

| | |
|---|---|
| Sex | n (%) |
| Male | 26 (74) |
| Female | 9 (26) |
| Age at FG diagnosis | |
| Median [IQR] | 52 [48, 58] |
| Race/ethnicity | n (%) |
| White | 23 (66) |
| Black | 5 (14) |
| Hispanic | 2 (6) |
| Asian | 1 (3) |
| Native American | 2 (6) |
| Other | 2 (6) |
| Smoking history? | n (%) |
| Yes | 20 (74) |
| No | 7 (26) |
| Missing | 8 |
| Preexisting condition | n (%) |
| Yes | 26 (96) |
| No | 1 (4) |
| Missing | 8 |
| FG severity index | |
| Median [IQR] | 6.5 [4.8, 8.3] |
| Number debridements | |
| Median [IQR] | 2 [1, 3] |
| Reconstruction performed? | n (%) |
| Yes | 19 (54) |
| No | 16 (46) |
| Type of reconstruction | n (%) |
| Primary repair with or without local flaps | 9 (47) |
| Primary repair with grafting | 10 (53) |
| Time to reconstruction (days) | |
| Median [IQR] | 17.5 [11.5, 29.5] |
| Length of hospital stay (days) | |
| Median [IQR] | 18 [9.5, 25.0] |

FG = Fournier's gangrene; IQR = interquartile range

range [IQR] or mean and standard deviation [SD]). CSFQ scores were illustrated separately for male and female respondents due to different thresholds for normal function. Kruskal-Wallis rank sum test (continuous variables) and Pearson's Chi-squared test (categorical variables) analyses were used for univariate comparisons. All analysis was conducted using R version 4.0.3.

## Results

### *Demographic and clinical characteristics*

A total of 35 patients responded to the CSFQ survey with 30 reporting corresponding VR-36 surveys. Demographic and clinical characteristics of the study cohort are displayed in Table 1. Nine patients were female, with a median age at diagnosis of 52 years (IQR [48, 58]) for the entire cohort. Most patients were white and almost 75% of respondents had a history of smoking. Virtually all patients had one or more preexisting conditions, with diabetes mellitus the most prevalent (24 of 27 respondents, 8 missing). The Fournier's Gangrene Severity Index (FGSI) ranged from 0 to 21, with a median 6.5 (IQR [4.8, 8.3]). The median number of debridements was 2 (IQR [1, 3]). Fifty-four percent of patients had some form of reconstruction, performed an average of 17.5 days post-debridement (IQR [11.5, 29.5]). Of the patients undergoing reconstructions, 47% received a primary repair with or without local flaps, while 53% received a primary repair with grafting. The average length of stay in hospital was 18 days (IQR [9.5, 25]).

### *Veterans RAND 36 (VR-36)*

Healthcare-related quality of life (HRQoL) measures of the VR-36 survey are reported in Table 2. Higher scores represent a higher HRQoL reported for that category. Respondent scores were compared to population-level averages reported by RAND Health Care, whose data is from the baseline of the Medical Outcomes Study.[23,24] FG patient respondents averaged below the population average in all component scores and the composite general health score, with the interquartile range among survey respondents rarely exceeding the population average. These survey results point to an overall decreased general HRQoL in patients who recover from FG.

### *CSFQ*

Sexual function scores from the CSFQ survey, reported in Table 3, are divided based on the five component dimensions of the survey and include a Total CSFQ Score. Higher scores represent better sexual function. Respondent scores were compared to the "Normal" thresholds for male and female respondents established by Clayton et al, with scores below these thresholds indicative of sexual dysfunction.[11,25,26]

FG patient respondents on average showed global sexual dysfunction via the Total CSFQ Score. The median Total CSFQ Score was 30.0 (29.0 for male, 36.0 for female) (IQR [20.0, 40.0]), compared to scores of > 47 and > 41 being considered normal sexual

TABLE 2. **VR-36 HRQoL survey responses (n = 30)**

| VR-36 category | Mean | SD | Population average |
|---|---|---|---|
| Physical functioning | 49.2 | 28.4 | 70.6 |
| Role limitation due to physical problems | 34.0 | 31.0 | 53.0 |
| Role limitation due to emotional problems | 53.9 | 33.0 | 65.8 |
| Energy/fatigue | 28.5 | 21.0 | 52.2 |
| Emotional well-being | 55.0 | 23.0 | 70.4 |
| Social function | 51.7 | 38.1 | 78.8 |
| Pain | 51.5 | 32.0 | 70.8 |
| General health | 33.0 | 18.6 | 57.0 |

function for males and females, respectively. Only 5 male patients and 1 female patient scored above the threshold for normal sexual function in this integrated metric.

Sexual dysfunction was also seen in each of the component dimensions that comprise the total CSFQ Score. FG patient respondents on average scored below the normal thresholds in each category. Notably, the median patient score for the "Pleasure" component among male respondents was the lowest possible value (1). These survey results point to an overall low sexual function quality of life in patients who recover from FG.

### *Determinants of sexual function in FG patients*

To identify factors that correlate with sexual function in patients recovering from FG, we divided patients into those above the median cohort Total CSFQ Score ("More Sexual Function," MSF) and those at or below the median ("Less Sexual Function," LSF). We compared demographic, clinical, VR-36, and component CSFQ metrics via univariate statistics, Table 4. Though few comparisons are significant due in part to small sample size, these comparisons reveal qualitative differences between FG patient respondents with "More" or "Less Sexual Function." Respondents in the MSF category are more often female ($p = 0.04$), and trend toward younger age ($p = 0.06$) and shorter time to reconstruction ($p = 0.09$), but longer hospital stays ($p = 0.09$). Respondents in the MSF category qualitatively trended toward a higher number of debridements and were more likely to undergo reconstruction via primary repair with or without local flaps, while respondents in the LSF category were more likely to undergo primary repair with grafting.

In terms of VR-36 quality of life metrics, respondents in the MSF category reported higher median component scores in Physical Functioning, Role Limitation due to Physical and Emotional Problems, Energy/Fatigue, and Social Function. Respondents in the MSF category had a significantly higher self-reported overall General Health score ($p = 0.04$). There were significant

TABLE 3. **VR-36 HRQoL survey responses (n = 30)**

| | Male respondents (n = 26) | | | Female respondents (n = 9) | | |
|---|---|---|---|---|---|---|
| **CSFQ category** | **Median** | **IQR** | **Normal threshold** | **Median** | **IQR** | **Normal threshold** |
| Pleasure | 1.0 | [1.0, 2.0] | > 4 | 3.0 | [1.0, 3.0] | > 4 |
| Desire/frequency | 4.0 | [3.0, 6.0] | > 8 | 6.0 | [4.0, 6.0] | > 6 |
| Desire/interest | 8.0 | [7.0, 10.0] | > 11 | 7.0 | [6.0, 8.0] | > 9 |
| Arousal/excitement | 5.5 | [3.3, 8.8] | > 13 | 7.0 | [5.0, 8.0] | > 12 |
| Orgasm/completion | 8.0 | [3.0, 10.0] | > 13 | 8.0 | [6.0, 11.0] | > 11 |
| **Total CSFQ score** | **29.0** | **[22.0, 36.5]** | **> 47** | **36.0** | **[34.0, 40.0]** | **> 41** |

TABLE 4. **Respondents with more/less sexual function**

| | Sexual function classification | | |
|---|---|---|---|
| | **Less sexual function (n = 18)** | **More sexual function (n = 17)** | **p value[1]** |
| Sex n (%) | | | 0.04 |
| Male | 16 (89%) | 11 (59%) | |
| Female | 2 (11%) | 7 (41%) | |
| Age | | | |
| Median [IQR] | 56.0 [51.3, 58.5] | 48.0 [41.0, 52.0] | 0.06 |
| Race/ethnicity n (%) | | | 0.39 |
| White | 12 (67%) | 11 (65%) | |
| Black | 3 (17%) | 2 (12%) | |
| Hispanic | 2 (11%) | 0 (0%) | |
| Asian | 0 (0%) | 1 (6%) | |
| Native American | 1 (6%) | 1 (6%) | |
| Other | 0 (0%) | 2 (12%) | |
| Smoking history? n (%) | | | 0.23 |
| Yes | 11 (85%) | 9 (64%) | |
| No | 2 (15%) | 5 (36%) | |
| Missing | 5 | 3 | |
| Preexisting condition? n (%) | | | 0.29 |
| Yes | 12 (92%) | 14 (100%) | |
| No | 1 (8%) | 0 (0%) | |
| Missing | 5 | 3 | |
| FG severity index | | | |
| Median [IQR] | 6.0 [2.0, 8.0] | 7.0 [5.0, 8.5] | 0.49 |
| Number of debridements | | | |
| Median [IQR] | 2.0 [1.0, 2.8] | 2.0 [2.0, 4.0] | 0.20 |
| Reconstruction performed? n (%) | | | 0.60 |
| Yes | 9 (50%) | 10 (59%) | |
| No | 9 (50%) | 7 (41%) | |
| Type of reconstruction n (%) | | | 0.25 |
| Primary repair with or without flaps | 3 (33%) | 6 (60%) | |
| Primary repair with grafting | 6 (67%) | 4 (40%) | |
| Time to reconstruction (days) | | | |
| Median [IQR] | 29.0 [14.0, 32.0] | 14.0 [9.5, 19.0] | 0.09 |
| Length of hospital stay (days) | | | |
| Median [IQR] | 15.0 [7.0, 22.3] | 20.0 [14.0, 32.0] | 0.047 |
| VR-36 health-related quality of life categories median [IQR] | | | |
| Physical functioning | 30.0 [20.0, 65.0] | 65.0 [40.0, 77.5] | 0.15 |
| Role limitation d/t physical problems | 25.0 [12.5, 28.1] | 37.5 [12.5, 75.0] | 0.25 |
| Role limitation d/t emotional problems | 50.0 [25.0, 70.8] | 66.7 [29.2, 75.0] | 0.63 |
| Energy/fatigue | 20.0 [7.5, 32.5] | 35.0 [17.5, 52.5] | 0.08 |
| Emotional well-being | 48.0 [38.0, 64.0] | 48.0 [40.0, 80.0] | 0.76 |
| Social function | 37.5 [25.0, 62.5] | 87.5 [18.8, 100.0] | 0.26 |
| Pain | 45.0 [22.5, 83.8] | 45.0 [27.5, 73.8] | 0.85 |
| General health | 25.0 [20.0, 30.0] | 40.0 [25.0, 52.5] | 0.04 |

TABLE 4 (Cont'd). **Respondents with more/less sexual function**

| | Sexual function classification | | |
|---|---|---|---|
| | **Less sexual function (n = 18)** | **More sexual function (n = 17)** | **p value[1]** |
| CSFQ component dimensions median [IQR] | | | |
| Pleasure | 1.0 [1.0, 1.0] | 3.0 [1.0, 4.0] | < 0.001 |
| Desire/frequency | 3.5 [3.0, 4.0] | 6.0 [6.0, 7.0] | < 0.001 |
| Desire/interest | 7.0 [6.0, 8.0] | 9.0 [8.0, 12.0] | < 0.001 |
| Arousal/excitement | 4.0 [3.0, 5.0] | 9.0 [7.0, 11.0] | < 0.001 |
| Orgasm/completion | 3.0 [3.0, 7.5] | 10.0 [8.0, 12.0] | < 0.001 |

[1]Pearson's Chi-squared test (categorical) or Kruskal-Wallis rank sum test (continuous); FG = Fournier's gangrene

differences between MSF and LSF respondents in each of the component dimensions that comprise the Total CSFQ Score, indicating that FG patient respondents with higher sexual function self-reported higher function across all component dimensions, including both physical (e.g., desire/frequency) and non-physical (e.g., desire/interest) categories.

## Discussion

We found deleterious long term impacts of FG on patients' sexual and overall quality of life through standardized questionnaires. Although female respondents score lower than male respondents in total CSFQ score in general patient populations, in our FG patient set female respondents self-reported higher metrics of sexual function.[27] FG patient respondents also reported overall reduced quality of life compared to population averages measured by the VR-36 survey, including both physical and non-physical component dimensions. Taken together, our surveys indicate lowered quality of life in sexual and general healthcare dimensions in the years following treatment of FG.

Our results mirror those from Czymek et al. In their multi-center study of 86 patients who received treatment for FG at five hospitals, they observed a deterioration in sexual function in 65% of patients, with sexual intercourse being impossible for 35% of their study cohort.[6] Czymek et al also noted that SF-36 physical role functioning, physical functioning, general health and physical health summary scores were significantly lower than those of the normal population.[6]

When comparing male and female patients, we found a higher rates of sexual dysfunction in male respondents. It is difficult to define the underlying mechanism, but future follow up with FG patients could discern the specific impact of FG-related outcomes on sexual and general health quality of life versus correlation of FG with other preexisting conditions. Based on collected patient comments, one mechanism for sexual dysfunction could be patient perceived genital deformity following postoperative difficulties leading to a negative impact on the emotional desire-driven aspects of arousal. The link between penile deformity and sexual function has previously been established, for example curvature in Peyronie's disease leading to men reporting a loss in sexual confidence, ability to initiate sex with a partner, and sexual interest.[28] Additionally, longitudinal investigation of males who undergo pediatric hypospadias repair revealed problems in erection, ejaculation, and intercourse in adulthood, suggesting that cosmetic outcome is related to better sexual outcome.[29] The use of skin grafting in penile reconstruction can prove to be a difficult reconstructive task and resulting penile deformities and tissue deficiencies can disturb sexual intercourse or make it impossible.[30] Comparatively, female sexual dysfunction following vaginal reconstruction appears to be less extreme in the literature, as some female patients experience no change in sexual function or even improved overall sexual function and report higher scores on standardized sexual function questionnaires.[31-34] Interestingly, excessive reconstruction of the genitourinary (GU) anatomy has been associated with poorer sexual function for bladder exstrophy patients, but not for FG patients. Nevertheless, this further bolsters the notion that surgical manipulation of the GU anatomy can alter future sexual functioning of urologic patients.[35,36]

We found that several factors influence sexual function in patients who recover from FG. For both genders, age had a borderline association with sexuality, with younger patients trending toward

higher sexual function. This is corroborated by well-studied changes in sexual activity with increasing age. For example, Eplov et al reported a decline in the level of sexual desire that stopped around 50 years in a national Danish study.[37] We also found that FG patient respondents with lower sexual function trended toward lower general health-related quality of life metrics, including significantly reduced self-reported overall general health, suggesting a possible influence of sexual health on overall feelings of wellbeing or a correlation of both quality of life metrics with other demographic or clinical factors.[37]

A strength of this study is the involvement of multiple institutions to provide a diverse patient cohort. Also, by being a multi-institutional study, it allows for diversity in surgeon practice and skill, which may lend to more generalizability to most academic practices. A limitation of this study is a lack of control group, as it is possible that patients with FG may have a low level of baseline sexual function due to age or other preexisting conditions. Our cohort also lacks data on sexual function prior to FG incidence, a limitation that we tried to mitigate via patient-reported outcome measures that are specific for change in function rather than a cross-sectional status. Finally, our sample set, though multi-institutional, remains small, made even smaller by our low response rate, making it impossible to link more specific indicators (e.g., type of reconstruction) to long term sexual and health-related quality of life, which could inform future standards of care. Additionally, the use of surveys after surgical intervention for FG exposes our study to recall bias.

## Conclusions

Overall, this study demonstrates patients treated for FG report high levels of sexual dysfunction in both physical and mental dimensions. This reported sexual dysfunction is accompanied by reduced general health-related quality of life. Our observations suggest a need for more consideration of the role of reconstruction after debridement or early wound closure to improve long term quality of life, which we believe will impact future practice in the treatment of FG patients. Our work also encourages future study of larger cohorts to identify specific factors that influence quality of life following treatment for FG. For example, we propose next steps to be the creation of multi-institutional prospective trial of a larger cohort of FG patients to investigate the demographic, clinical, and/or surgical variables that impact HRQoL and sexual function for FG patients over longer time periods following treatment for FG. □

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