

Quality of Life After Abdominal Wall Reconstruction Following Open Abdomen

Ben L. Zarzaur, MD, MPH, Jennifer M. DiCocco, MD, Charles P. Shahan, BS, Katrina Emmett, MD, Louis J. Magnotti, MD, Martin A. Croce, MD, Donna K. Hathaway, PhD, and Timothy C. Fabian, MD

Background: Management of intra-abdominal hypertension with an open abdomen and planned ventral hernia results in decreased mortality. But, delayed abdominal wall reconstruction (DAWR) is necessary. Results after DAWR demonstrate acceptable recurrence, morbidity, and mortality rates. However, little is known about quality of life (QOL) after DAWR. The purpose of this study was to analyze QOL after DAWR.

Methods: Patients who had DAWR >15 years were identified from operative logs of a trauma center. Patients were contacted, and a QOL assessment was administered in person or via telephone. The QOL assessment contained the Short-Form 36-Item Health Survey 1.0, the Posttraumatic Stress Disorder (PTSD) Checklist-Civilian Version, and the Centers for Epidemiologic Studies Depression Scale.

Results: The QOL assessment was completed by 41 of 152 patients. The indication for open abdomen was injury in 37 (90%) and emergency operation in 4 (10%). Time to follow-up ranged from 9 months to 14.6 years after DAWR. Of 31 patients working before DAWR, 23% had not returned to work secondary to DAWR. Also, 65% screened positive for depression and 23% screened positive for PTSD. Compared with population norms Physical Component Scores were significantly lower for the study population ($41.1 \pm 13.2, p < 0.05$).

Conclusion: Patients who undergo DAWR have decreased physical functioning and have a high prevalence of PTSD and depression. Consideration should be given to screening for depression and PTSD in this patient population.

Key Words: Open abdomen, Quality of life, Planned ventral hernia, Outcomes.

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The open abdomen has become a key management technique used in the setting of intra-abdominal hypertension (IAH). The open abdomen allows a patient at risk for or with IAH to avoid adverse consequences associated with IAH including decreased renal and gut perfusion and impaired pulmonary efficiency. More importantly, the use of the open

abdomen in the setting of IAH is associated with decreased acute morbidity and mortality.^{1–3} The successful management of these acutely ill patients has resulted in the creation of a longer term problem. Although anywhere from 20% to 75% of surviving patients managed with an open abdomen will have the abdominal fascia closed before discharge, the remaining patients may undergo abdominal wall reconstruction (AWR) using a staged management technique that has been described in detail elsewhere.^{4–10} Although the morbidity, mortality, and recurrence rates have been reported, there has been little focus on the quality of life (QOL) and functional outcomes of patients after AWR.

The acute impact of injury on overall QOL is well documented. As described by others, there is a sharp decrease in QOL after injury with a recovery to near baseline over a period lasting at least 1 year.^{11–14} However, most of these studies were broad based with little focus on patients managed with open abdomens. Because AWR after open abdomen often takes place during the first year after injury and before QOL and functional ability returns to near baseline, patients with open abdomens suffer a “second-hit” to QOL and functional ability when they undergo AWR. Cheatham et al.^{15,16} reported long-term outcomes of patients managed with open abdomens in a series of two articles. Although the authors demonstrated an acute decrease in QOL in both studies, they showed that the patients recovered to near normal QOL after AWR. However, the follow-up in both studies was limited, and there were no measures of depression or posttraumatic stress disorder (PTSD) reported in either study. The purpose of this study is to describe the QOL of patients who have undergone AWR after discharge with an open abdomen and to describe the prevalence of depression and PTSD in this patient population. Because recurrence and time from repair could influence QOL after AWR, we stratified patients based on recurrence status and based on the time since AWR.

MATERIALS AND METHODS

Patient Selection, Patient Management, and Data Collection

After approval from the University of Tennessee Health Science Center Institutional Review Board, patients who had undergone AWR after management with an open abdomen were identified from the operative logs at the Presley Regional Trauma Center from 1993 to 2008. All patients iden-

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From the Department of Surgery (B.L.Z., J.M.D., C.P.S., K.E., L.J.M., M.A.C., T.C.F.); and School of Nursing (D.K.H.), University of Tennessee Health Science Center, Memphis, Tennessee.

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Address for reprints: Ben L. Zarzaur, MD, MPH, Department of Surgery, University of Tennessee Health Science Center, 910 Madison Building, 2nd Floor, Memphis, TN 38163; email: bzarzaur@uthsc.edu.

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tified were eligible for follow-up. All medical records were reviewed starting from the initial hospitalization at the time the open abdomen was created to the time of follow-up for this study. Information obtained from medical records from the initial hospitalization included demographics, comorbidities, mechanism and severity of injury, and the indication for open abdomen. Operative reports were reviewed from the time of AWR for the type of repair used and the performance of associated procedures, such as stoma take down. Early and late postoperative complications were recorded by review of hospital charts and clinic notes.

The approach used at the Presley Regional Trauma Center for the management of patients with an open abdomen has been described in detail elsewhere.^{4,5} Briefly, a three-stage approach is used. In stage I, absorbable mesh (polyglactin 910 woven mesh) is sewn to the fascia or skin for temporary abdominal closure. Attempts at pleating the mesh are made at the bedside during the first 7 days to 10 days. If the fascia cannot be closed as a result of ongoing loss of domain, granulation tissue is allowed to form. Stage II consists of removal of the absorbable mesh and split-thickness skin grafting of the open abdominal wound. Stage III is the definitive reconstruction of the abdominal wall using, primarily, the modified components separation technique described by Fabian et al.⁴ Other techniques used included standard components separation and closure without separation.

Follow-Up and QOL Determination

Using the last known contact information, eligible patients were telephoned and asked to return to the outpatient clinic for an examination. Patients were asked to complete a battery of QOL survey instruments described below. When no valid contact information was available, an online locator service (<http://www.peoplefinder.com>) was queried for the patient and all known associates to obtain additional numbers. All valid telephone numbers were called until follow-up was completed. Patients were deemed lost to follow-up or dead when all contact information was exhausted or if the patient was found in the Social Security Death Master File, respectively.

At the time of follow-up, patients were asked to complete a battery of survey instruments. These included the Short-Form 36-Item Health Survey-version 1 (SF-36), Center for Epidemiologic Studies Scale for Depression (CES-D), and the Posttraumatic Stress Disorder Check List-Civilian (PCL-C). The SF-36 was developed from more detailed measures used in the Medical Outcomes Study¹⁷ and has become the most commonly used generic QOL measure. The SF-36 can be given as a self-administered or interview-based format. The SF-36 assesses health status in eight areas: physical functioning (PF), physical role limitations, emotional role limitations, pain, social functioning, energy or fatigue, emotional well-being, and general health perceptions.¹⁷ Each question is answered either yes or no or on a scale with three to six dimensions. Responses are designed to reflect the person's status during the previous 4 weeks. Questions are combined to form composite scores in each of the eight areas.¹⁷ These scores range from 0 to 100. Subscale scores can be combined into two profile

summaries, the mental health and physical summary scores. The SF-36 has been used in numerous studies of the impact of injury on QOL and published guidelines endorse the use of the SF-36.^{18,19}

The CES-D assesses the severity of depressive symptoms using a well-validated 20-item scale.²⁰ The measure is valid and reliable across a wide variety of general populations and is widely used in the injured patient population.²¹ Response categories indicate the frequency of occurrence of each item and are scored on a 4-point scale. Total scores can range from 0 to 60. Scores of ≥ 16 were considered a positive screen for depression for this study.^{12,13,22}

In the PCL-C, respondents rate the extent to which they are bothered by 17 different symptoms corresponding to criteria for the diagnosis of PTSD. Each item is rated on a 5-point Likert scale. Possible scores range from 17 to 85, with higher scores indicating a greater likelihood of PTSD. Persons with a score of ≥ 50 on the PCL-C were designated as screening positive for PTSD.²³

Patients were stratified based on two factors. The first factor was whether the patient suffered a recurrence at any-time since AWR or not. The second stratification factor was time since AWR. Patients ≤ 5 years out from AWR were compared with patients who were >5 years out from AWR. Scores on the SF-36, the prevalence of depression and PTSD, and whether the patient had returned to work were compared in both strata.

Statistical Analysis

Data were managed and analyzed using SAS version 9.1 (SAS Institute, Cary, NC). Raw scores for each of the eight domains of the SF-36 and the two component summary scores were calculated using methods outlined for the SF-36 version 1 (Quality Metric, RI). To allow comparison to United States (US) population norms, the raw scores were normalized to a mean of 50 ± 10 points. Continuous data are reported as the mean \pm standard deviation. Categorical data are reported as percent of the group from which they were derived unless otherwise specified. For statistical comparisons, categorical data were compared using χ^2 tests or Fisher's exact test whichever was appropriate. Continuous data were analyzed using Student's *t* tests. A $p < 0.05$ was considered significant.

RESULTS

Patient Characteristics, Management, and Follow-Up

During the 15-year period of the study, there were 152 patients who underwent AWR after discharge with an open abdomen. There were 44 patients who either died or were considered lost to follow-up. Of the remaining 108 patients, 41 completed the QOL surveys. These 41 patients made up the population for this study. The vast majority of the patients was men (78%) and had an open abdomen after suffering an injury (90%). Of those who had an open abdomen as a result of injury, 51% suffered a penetrating injury. Mean injury severity score was 25.9 ± 11.4 . The most common indication

for an open abdomen was visceral edema (63.4%). The mean age at the time of AWR was 36.0 years ± 12.1 years. Methods of AWR included fascial reapproximation without separation of components or the use of prosthetic mesh in 4.9%. Primary fascial closure with prosthetic mesh was performed in 4.9%. Components separation without mesh was used for 22% of the patients and components separation with mesh was used for 9.8%. Modified components separation was used for 24.4% and modified components separation with mesh was used for the remaining 34%. The mean age at the time of follow-up was 41.9 years ± 12.9 years. Time from definitive repair to follow-up ranged from 8.7 months to 14.6 years with a mean time of ~6 years (71.0 months ± 55.5 months).

QOL, Mental Health, and Employment Outcomes for the Study Population

The overall SF-36 results are shown in Figure 1. Compared with United States population norms, the patients who suffered an open abdomen and subsequently underwent AWR had significantly lower Physical Component Scores (PCS). As expected, the five domains that make up the PCS [PF, role physical, bodily pain, general health, and energy or vitality] were significantly lower than US population norms as well. The role emotional domain was the only domain of the Mental Health Component score that was significantly lower than US population norms. However, 65% of the patients screened positive for depression and 22.5% screened positive for PTSD. Considering employment outcomes, 31 patients were working before suffering an open abdomen and 18 of those (58%) had returned to work by the time of follow-up. For the 13 patients who had not yet returned to work, 7 had not returned to work because of the planned ventral hernia

even after AWR and 6 had not returned to work for other reasons.

QOL, Mental Health, and Employment Outcomes by Recurrence and Time From Reconstruction

Because recurrence of the ventral hernia after AWR and time from AWR could influence QOL, mental health, and employment outcomes, patients were stratified based on these factors at the time of data analysis. There were no significant differences in the characteristics of patients when compared by either recurrence after AWR status or time since AWR (≤5 years vs. >5 years) as shown in Table 1. Patients who suffered a recurrence had significantly lower PCS on the SF-36 compared with those who did not have a recurrence (Fig. 2). There were no differences in terms of the prevalence of depression or PTSD or employment status when patients were stratified by recurrence (Tables 2 and 3). Patients who were ≤5 years from the time of AWR had significantly lower SF-36 scores in both component scores and in all domains except for the PF domain compared with those who were >5 years from repair (Fig. 3). There were no differences in the prevalence of PTSD, depression, or return to work status when the patients were stratified by time from repair (Tables 2 and 3). To further explore time from AWR and return to work, patients working before injury were stratified by 2 years, 4 years, and 6 years from AWR. For those <2 years out from AWR, 43% had returned to work. For those 2 years to 4 years from AWR, 60% had returned to work. Sixty-seven percent of patients who were between 4 years and 6 years from AWR had returned to work and 63% of those >6 years from AWR had returned to work. Patients who were depressed or who had PTSD had significantly lower SF-36 scores across all domains and composite scores compared

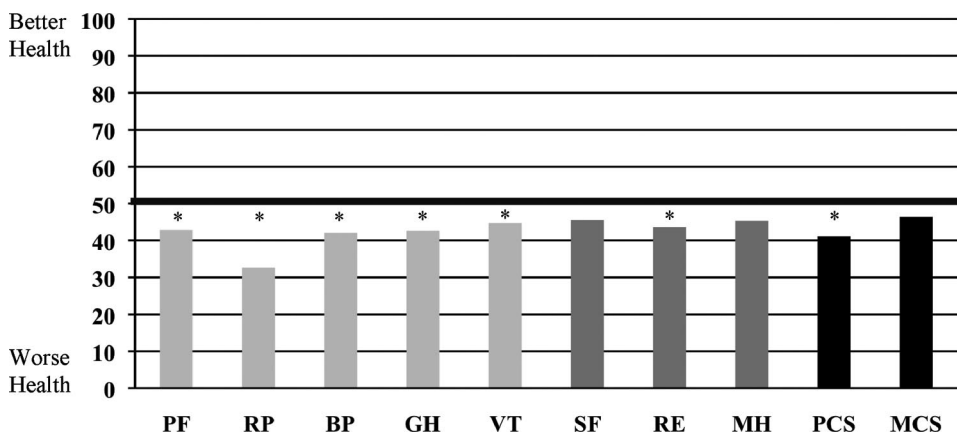


Figure 1. Mean SF-36 scores for patients after AWR (n = 41). The dark black line at 50 indicates the population norm for the United States. The domains that make up the PCS of the SF-36 are represented by light grey bars (PF, role physical [RP], bodily pain [BP], general health [GH], and vitality [VT]). The domains that make up the Mental Component Score (MCS) of the SF-36 are represented by the dark grey bars (social function [SF], role emotional [RE], mental health [MH]). The PCS and the MCS are represented by black bars. The asterisk indicates that the SF-36 domain or component score was significantly different compared with the United States population norm for that domain or component score ($p < 0.05$).

TABLE 1. Characteristics of Respondents to QOL Survey After AWR by Recurrence of Hernia and Time From Definitive Repair

Characteristic	Recurrence		p	Time Since Repair		p
	No (n = 31)	Yes (n = 10)		≤5 yr (n = 21)	>5 yr (n = 20)	
Age at repair (yr)	35.0 ± 12.5	39.1 ± 10.8	0.36	35.9 ± 12.5	36.2 ± 11.9	0.93
Male (%)	84	60	0.18	90	65	0.07
Body mass index	28.3 ± 5.6	31.8 ± 7.3	0.12	30.5 ± 6.8	27.7 ± 5.0	0.15
Injured (%)	94	80	0.25	95	85	0.34
Blunt (%)	52	38	0.69	40	59	0.33
ISS	25.4 ± 12.0	29.0 ± 8.0	0.58	25.6 ± 11.2	26.5 ± 12.5	0.85
Comorbidity (%)*	65	50	0.47	67	55	0.53
Open abdomen indication			0.39			0.07
Visceral edema	61	70		48	80	
Loss of abdominal wall	10	20		14	10	
Other	29	10		38	10	
Repair method (%)			n/a			n/a
Primary fascial closure	7	0		0	10	
Mesh only	7	0		0	10	
Components	22	20		24	20	
Components + mesh	3	30		14	5	
Modified components	29	10		14	35	
Modified components	32	40		48	20	

ISS, Injury Severity Score.

* Comorbidities included history of diabetes, hypertension, chronic steroid use, alcohol abuse, or smoking.

Values are presented as mean ± SD and n (%).

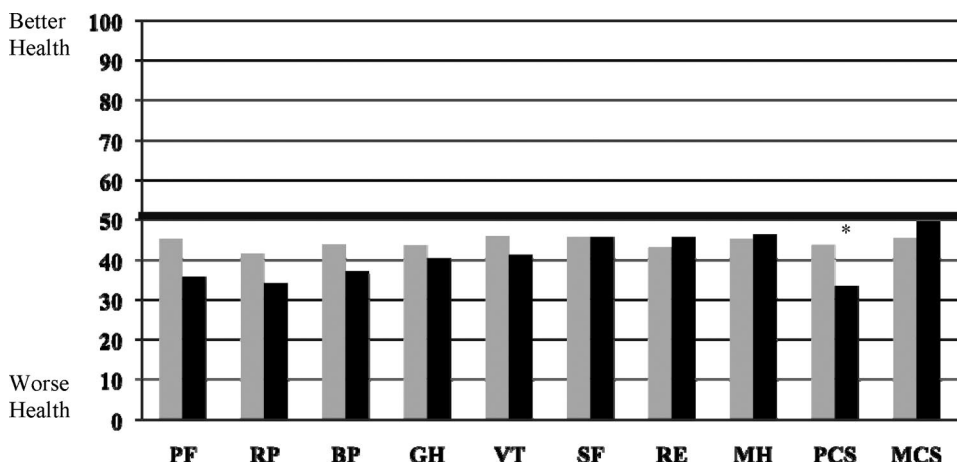


Figure 2. Mean SF-36 scores for patients after AWR by recurrence (n = 41). The grey bars represent the patients who did not have a recurrence (n = 31). The black bars represent patients who had a recurrence (n = 10). PF, role physical (RP), bodily pain (BP), general health (GH), vitality (VT), social function (SF), role emotional (RE), mental health (MH), and PCS, mental component score (MCS). The asterisk indicates that the SF-36 domain or component score was significantly different in those patients who had a recurrence compared with patients who did not have a recurrence (p < 0.05).

with those who were not suffering from PTSD or depression, respectively (data not shown).

DISCUSSION

For those with or at risk for IAH, the open abdomen is an opportunity to decrease short-term morbidity and mortality. Survivors of the initial insult leading to management with an open abdomen, although avoiding the complications of associated with IAH, are placed at risk for the complications that may arise from an open abdomen. Namely, the patients are at risk for

formation of an enteroatmospheric fistula; they are committed to at least several months with a large, disfiguring ventral hernia; and they have the prospect of major operation to definitively reconstruct the abdominal wall. The short- and long-term outcomes of patients with open abdomens have been well documented in previous studies from our institution as well as others.⁴⁻¹⁰ We recently reported our experience, in the same patient population as this study, with recurrence after AWR. We showed, as others have, that the long-term recurrence rate is 5% for patients who undergo the modified components separation tech-

TABLE 2. Mental Health Outcomes of Respondents to QOL Survey After AWR by Recurrence of Hernia and Time From Definitive Repair (n = 41)

Outcome	Recurrence		p	Time Since Repair		p
	No (n = 31)	Yes (n = 10)		≤5 yr (n = 21)	>5 yr (n = 20)	
Posttraumatic stress disorder*			0.82			0.58
Yes	7 (23)	2 (20)		5 (24)	2 (10)	
No	24 (77)	8 (80)		16 (76)	18 (90)	
Depression†			0.70			0.18
Yes	19 (61)	7 (70)		16 (76)	11 (55)	
No	12 (39)	3 (30)		5 (24)	9 (45)	

* Scores ≥50 on the Posttraumatic Stress Disorder-Civilian checklist. Results are reported as n (%).

† Scores ≥16 on the Centers for Epidemiologic Studies Scale for Depression. Results are reported as n (%).

TABLE 3. Employment Outcomes after AWR of Respondents Who Worked Before Injury (n = 31)

Outcome	Recurrence		p	Time Since Repair		p
	No (n = 23)	Yes (n = 8)		≤5 yr (n = 13)	>5 yr (n = 18)	
Worked after repair (%)*			0.49			0.89
Yes	14 (61)	4 (50)		7 (54)	11 (61)	
No—not related to hernia	5 (22)	1 (13)		3 (23)	3 (17)	
No—related to hernia	4 (17)	3 (37)		3 (23)	4 (22)	

* Results are reported as the percent of patients within category from which they were derived, n (%).

nique without mesh to around 20% for those who require mesh for definitive closure.²⁴ Most studies in similar patient populations have shown recurrence rates of about 25% to 30%.⁶⁻⁹

The key question regarding QOL in the setting of AWR is does the extraordinary effort involved with the open abdomen result in not only acceptable long-term clinical outcomes but does it also result in tolerable QOL for these patients? Patients with a planned ventral hernia are often still recovering from their original injury at the time of AWR. The acute decrease in QOL after injury is followed by a general upward trajectory as recovery takes place during the subsequent 12 months to 18 months. Repair of the abdominal wall, which is essentially a major elective injury, often occurs while these patients are in the midst of recovery from the original injury. This “second-hit” may slow their recovery or limit the ability to return to baseline.

In the first study to begin to answer this question, Cheatham et al. retrospectively reviewed 30 patients who were managed with an open abdomen. The authors compared those who had already undergone definitive closure to those who were still awaiting closure. The authors found that for

the 11 patients who had not yet undergone AWR, there was significant impairment in QOL as measured by the SF-36 across all the physical domains. Although the mental component summary score was not significantly different from population norms for the open abdomen population, the social functioning and role-emotional domains were significantly lower than population norms. For the 19 patients who had undergone AWR after an open abdomen, the mental domain scores had returned to population norms and nearly all the physical domain scores had returned to population norms with the exception of the PF and role-physical scores. Additionally, 78% of the patients who were working before the injury resulting in an open abdomen had returned to work.¹⁴ This study was followed by a prospective, observational study by the same lead author. In the prospective study, patients who were discharged with an open abdomen initially had significantly decreased QOL as measured by the SF-36 in all domains compared with population norms. During the subsequent 2-year period, 60% had undergone definitive repair and the QOL of these patients returned to a level that was no different from population norms.¹⁵

Similar to the study of Cheatham et al., we found that there was no significant difference in the Mental Component Summary score of the SF-36 compared with population norms for those who had undergone AWR of an open abdomen. Unlike the study of Cheatham et al., we found that despite reconstruction of the abdominal wall, there was still a significant decrease in the physical domains of the SF-36. Factors that were associated with decreased SF-36 scores in both the mental and physical components were the presence of PTSD or depression or having suffered a recurrence. Time was also a factor. Patients who were <5 years from the time of AWR had significantly lower scores across all domains except PF.

Return to work, unlike the more subjective SF-36, is an outcome that is objectively measured. For this outcome measure, only 18 of 31 (58.1%) of patients who were working before injury were working after AWR. Neither time from AWR nor suffering a recurrence was associated with employment status. These results are lower than observed in the study of Cheatham et al. but are consistent with other studies in the severely injured patient population.^{11,14}

As mentioned above, PTSD and depression were associated with significantly lower QOL in all domains compared with those without PTSD or depression in patients after AWR. We found an overall prevalence of 65% for depression and 22.5% for PTSD. Other studies have found a similar prevalence of PTSD and depression after moderate to severe injury. Kiely et al.¹² followed 312 patients for 6 months after injury. The authors found that for the outcomes of depression and PTSD, 19.9% and 30.3% of patients reached scores on the PCL-C and CES-D that signify elevated risk of PTSD (1 month) and depression (6 months), respectively. In a similar study, Michaels et al. followed moderately to severely injured persons for 1 year. Subjects were surveyed at 6 months and 12 months via mail. The mail survey included measures of depression and PTSD. With regard to psychologic outcomes, at baseline, ~20% of the subjects had symptoms consistent

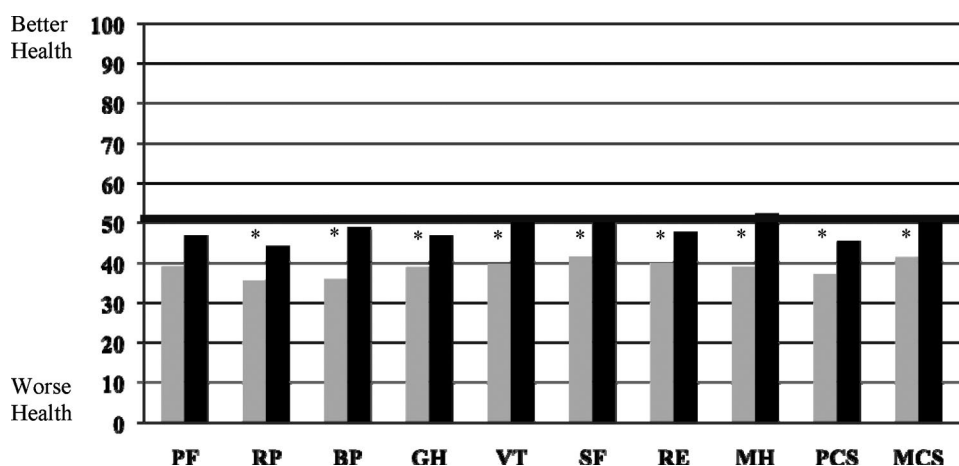


Figure 3. Mean SF-36 scores for patients after AWR by years from repair ($n = 41$). The grey bars represent patients who are ≤ 5 years from the time of repair ($n = 21$). The black bars represent patients who are > 5 years from the time of repair ($n = 20$). PF, role physical (RP), bodily pain (BP), general health (GH), vitality (VT), social function (SF), role emotional (RE), mental health (MH), PCS, and mental component score (MCS). The asterisk indicates that the SF-36 domain or component score was significantly different in those patients who were ≤ 5 years from the time of repair compared with patients who > 5 years from the time of repair ($p < 0.05$).

with depression, but by 6 months $\sim 40\%$ of the subjects had symptoms of depression. Additionally, at 6 months and 12 months, $\sim 40\%$ of the subjects reported symptoms consistent with PTSD.¹⁴

With the high prevalence of psychiatric symptoms in this patient population, it might be appropriate to develop protocols for involvement of mental health professionals in their long-term care. This type of intervention is not unheard of among injured patient populations associated with prolonged recovery periods and significant disruption of pre-injury functional status. Interventions ranging from simple to more complex have been shown to be effective in patients who have suffered burns, traumatic brain injury, and admission to a trauma center after a severe injury.^{25–27} Similar interventions in patients managed with an open abdomen may improve the long-term psychiatric outcomes of these patients. Clearly, more study is needed to better define the optimal type and timing of mental health interventions needed in the AWR patient population.

As with other retrospective survey studies, this study suffers from the potential of response bias. It may be that because only 38% of eligible patients completed the entire QOL survey, we cannot be sure that the respondents are similar to those who did not complete the survey in terms of QOL. However, the patients who did not complete the survey were no different in terms of injury severity, demographic factors, or recurrence rate. The small sample size limited our ability to use multivariable models to analyze potential predictors of poor QOL outcome in this patient population. Furthermore, the results of this study may not be able to be generalized to patients treated with a staged management technique different from the one used at the Presley Regional Trauma Center.

For our measure of QOL, we used the SF-36. The SF-36 has been used extensively in many different disease states as well as in injured patients and is the recommended

QOL measure in the injured patient population. However, the SF-36 does have some drawbacks in the injured patient population. In particular, there is a ceiling effect. That is, the instrument has a difficult time discriminating at the higher levels of functioning.²⁸ In our study, this is evidenced by the normal Mental Component Summary scores for the study population despite the high prevalence of positive screening tests for PTSD and depression in this population.^{18,19}

Regarding the depression and PTSD outcome used in this study, it is important to keep in mind the limitations associated with the screening instruments used. For depression screening in the study population, we used the CES-D. This instrument was developed in 1977 and has been widely used since that time. A limitation associated with its use, however, is that there can be a relatively high false positive rate, on the order of 15% to 20% using the same cut-off value used for this study (a score of ≥ 16).^{20,29} A similar issue arises when using the PCL-C for the PTSD outcome in this study. The sensitivity of the PCL-C has been measured at 0.82 and specificity of 0.83 using a cut-off score of 50.²³

The retrospective nature of this study limited our ability to account for the myriad of issues associated with QOL outcome in patients with an open abdomen. It is likely that many factors such as injury type, socioeconomic status, the circumstances surrounding the injury, particularly if violence was involved, as well as other factors could have contributed to poor QOL outcomes in these patients. Because of this, it is important not to overstate associations between measured factors and QOL outcome in these complex patients.

Despite these concerns, this study represents the longest follow-up for patients after AWR that considered QOL as an outcome. The results indicate that even after open abdomen and AWR, patients can return to near normal QOL. Patients may continue to improve past 5 years and early decreases in QOL do not necessarily mean that they will continue to suffer impaired QOL. Because recurrence is

associated with decreased QOL in terms of physical outcome, efforts should focus on minimizing the potential for this complication. Several authors have published their recurrence rates using various reconstruction techniques. Many of these studies are single center with variable periods of follow-up. A multicenter prospective study of open abdomen and AWR techniques should be undertaken to analyze which surgical approach results in the least recurrence. Because a high number of patients in this study screened positive for PTSD and depression using standard cut-off values on the PCL-C and the CES-D, perhaps routine screening for these outcomes should be performed. In addition, mental health interventions could be designed and implemented to mitigate the poor psychologic outcomes in these complex patients. Again, a multicenter prospective study might be able to more conclusively address the QOL outcomes associated with AWR. In the meantime, this study along with the results from the studies performed by Cheatham et al. will provide surgeons with information regarding QOL outcomes that may help in counseling patients with open abdomens regarding what to expect during the often long recovery phase.

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