



## Long-term quality of life after posterior cervical foraminotomy for radiculopathy



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### ABSTRACT

**Objectives:** Cervical radiculopathy may cause symptoms and loss of function that can lead to a significant reduction in health related quality of life (HRQOL). As part of a comprehensive review of long-term outcomes, we examined HRQOL in a large cohort of patients undergoing posterior cervical foraminotomy (FOR) for radiculopathy.

**Patients and methods:** 338 patients who underwent FOR between 1990 and 2009 participated in a telephone interview designed to measure symptomatic and functional improvements following surgery. We also administered the EQ-5D, a standardized tool for assessing HRQOL. We analyzed this data for associations between patient and treatment characteristics, improvements in symptoms and function, and HRQOL as measured by the EQ-5D.

**Results:** Mean follow-up was 10.0 years. The average EQ-5D at follow-up was  $0.81 \pm 0.18$ , and improvements in pain, weakness and function as well as ability to return to work correlated with improved EQ-5D score ( $p < 0.0001$ ). There was no correlation between length of follow-up and EQ-5D score ( $p = 0.980$ ). Additionally, there was no difference between mean EQ-5D score for soft disc versus osteophyte pathology (0.84 versus 0.81,  $p = 0.21$ ).

**Conclusion:** These data provide evidence that FOR for cervical radiculopathy is associated with improved HRQOL at long-term follow-up. The lack of correlation between length of follow-up and HRQOL suggests that FOR is a durable treatment option. Moreover, FOR is associated with improved HRQOL whether radiculopathy is due to soft disc or osteophyte pathology.

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### 1. Introduction

Cervical radiculopathy is a significant public health problem with a prevalence of 3.5 cases per 1000 population and an annual incidence of 0.1% worldwide [1–3]. Patients may present with arm pain, weakness, or sensory changes, which may result in disability and a substantial reduction in health related quality of life (HRQOL) [4]. Conservative management such as pharmacotherapy, physical therapy, and steroid injection can be effective at times, but surgical intervention is needed in refractory cases [5–7]. Posterior cervical

foraminotomy (FOR) is a well-established surgical treatment for radiculopathy and is associated with resolution of symptoms and improved quality of life [8–11]. However, a recent Cochrane review of surgical treatments for cervical radiculopathy and myelopathy concluded that a high level of evidence for a surgical benefit on disease progression is lacking currently [12]. The authors suggested, “future research into radiculopathy should focus on the long term effect of surgery. . .”

Patient-reported outcome measures including HRQOL are critical for assessing treatment efficacy of spine surgery because symptoms such as pain are difficult to measure objectively [13–15]. The EQ-5D is a validated and now well-established five-dimensional self-assessment tool that measures HRQOL [16–18]. To date, several studies have investigated cervical spondylosis treatment outcomes with the EQ-5D [19–21], but there is a scarcity of

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long-term studies. In the present study, we measured long-term HRQOL as part of a large, retrospective, comprehensive review of outcomes of FOR for cervical radiculopathy [8]. We sought to measure the effect of FOR on HRQOL by correlating EQ-5D scores with improvements in symptomatic and functional outcomes. We also examined the impact of the pathology (soft disc versus osteophyte disease) on HRQOL at long-term follow-up.

## 2. Materials and methods

We reviewed patient records at Pennsylvania Hospital using ICD procedural codes to identify all patients who underwent FOR from 1990 to 2009. Our search yielded 1085 FOR surgeries performed among 1039 patients. Surgeries were performed by the study's three senior authors (FS, SD, WW). All patients who underwent FOR for C3–C8 radiculopathy were included. The surgical approach has been described elsewhere [22–25]. Charts were then reviewed for demographic information, medical comorbidities, preoperative symptoms, pathology (soft disc versus osteophyte disease) as noted in the operative report, and surgical complications. Patients were excluded if they had a previous cervical fusion at the same level, spinal neoplasm, or evidence of myelopathy. Patients meeting inclusion criteria were asked to participate in a short, structured telephone interview, which included questions about current symptoms as well as the EQ-5D. Those who had undergone multiple FORs were asked the same questions for each surgery. Interviews were conducted over a 45-day period.

The EQ-5D records patients' ratings of mobility, self-care, daily activities, pain or discomfort, and anxiety or depression. One of three levels (1 = no, 2 = some, 3 = severe problems) are chosen by the patient for each dimension. Responses are then converted to a global index (0 = death, 1 = perfect health) using a standard algorithm [26]. This score can be converted to QALYs by multiplying by the average duration of follow-up in years. A visual analog scale (0–100) that assesses overall self-impression of health is included. Although some have expressed concern about the sensitivity of the three-level version, the EQ-5D remains a commonly used, valid, and reliable HRQOL measure [17,19,27,28].

Results of the EQ-5D were correlated with variables of interest, including symptomatic and functional outcomes as assessed during the telephone interview, medical comorbidities, presence and duration of preoperative symptoms, pathology (soft disc versus osteophyte disease), surgical complications, recurrence requiring reoperation, and length of time between surgery and follow-up. Pairs of means were compared using a *t*-test. Uni- and multivariate regression analyses were performed to test the influence of covariates on EQ-5D scores. A *p*-value of <0.05 was considered statistically significant. This study was approved by our IRB, and patients gave their verbal, informed consent.

## 3. Results

A total of 338 interviews were completed among 319 patients at a mean follow-up of 10.0 years. Thirteen of the patients underwent 2 FORs and 3 underwent 3 FORs. These patients answered questions for each of the operations performed, and length of follow-up was calculated as an average for all surgeries performed. At the time of interview, mean age was 60.1 years. There were 165 (51.7%) male and 154 (48.3%) female patients.

Results of the EQ-5D at follow-up are shown in Table 1. The average EQ-5D score was  $0.81 \pm 0.18$ . In the overall cohort, 45% of cases revealed purely soft disc. The complication rate was 3%. Principal complications included surgical site infection (2%), dural breach (0.5%), and new weakness (0.5%). The rate of recurrent radiculopa-

**Table 1**  
EQ-5D results at follow-up.

EQ-5D dimensions	n (%)
Mobility	
No problems	221 (65.4)
Moderate problems	114 (33.7)
Severe problems	3 (0.9)
Self-care	
No problems	303 (89.6)
Moderate problems	34 (10.1)
Severe problems	1 (0.3)
Usual activities	
No problems	204 (60.4)
Moderate problems	125 (36.9)
Severe problems	9 (2.7)
Pain/discomfort	
No problems	140 (41.4)
Moderate problems	170 (50.3)
Severe problems	28 (8.3)
Anxiety/depression	
No problems	260 (76.9)
Moderate problems	70 (20.7)
Severe problems	8 (2.4)
Visual analogue scale average	80.3

thy involving the same level and side and requiring FOR or anterior or posterior decompression and arthrodesis was 6.2%.

There was no difference between mean EQ-5D score for soft disc versus osteophyte pathology (0.84 versus 0.81,  $p = 0.21$ ). Although EQ-5D score at follow-up appeared to decline with increased age at surgery, this correlation was not significant ( $p = 0.055$ ) (Fig. 1). Additionally, there was no correlation between length of follow-up and EQ-5D score ( $p = 0.980$ ) (Fig. 2).

Other pre- and perioperative predictors of EQ-5D included absence of medical comorbidities (hypertension, coronary artery disease, diabetes, osteoarthritis, rheumatoid arthritis, congestive heart failure, connective tissue disease, trauma;  $p = 0.001$ ). Of the individual comorbidities, diabetes, trauma and connective tissue disease were significant. The preoperative symptom duration (median = 12 weeks) was significant in the univariate model, but it fell out in the multivariate model. All other factors including surgeon, estimated blood loss, and complications did not predict EQ-5D score at follow-up.

As previously reported, approximately 90% of patients described improved pain, weakness or function following FOR, and 93% of patients who were unable to work prior to surgery were able to return [8]. In the present analysis, improvements in pain, weakness and function as well as ability to return to work correlated with improved EQ-5D score ( $p < 0.0001$ ). While need for additional non-surgical treatment was associated with lower EQ-5D score ( $p < 0.0001$ ), need for additional surgery was not ( $p = 0.103$ ).

## 4. Discussion

Symptoms of cervical radiculopathy dramatically impact an individual's HRQOL. Untreated symptoms contribute to co-morbid depression and anxiety as well as lost workdays, medical disability, and a decrease in activities of daily living [4]. We previously reported that FOR for radiculopathy results in symptomatic and functional improvements in 90% [8]. In the present analysis, we demonstrate that these gains are significantly associated with improvements in HRQOL at long-term follow-up. Moreover, HRQOL did not correlate with age at surgery or length of follow-up suggesting that FOR is well tolerated in all age groups and yields improvements that are stable up to 19 years postoperatively (Fig. 2).

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