



Return to golf after adult degenerative and deformity spine surgery: a preliminary case series of how surgery impacts golf play and performance

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Background: Golf is a commonly played sport among older adults, and degenerative and/or deformity spine pathology can severely impact older individuals' ability to play golf. In a cohort of self-identified, avid golfers undergoing degenerative or deformity spine surgery, we report their: (I) presentation, (II) operative treatment, and (III) return-to-play (RTP) process.

Methods: A retrospective case series of self-identified, avid golfers undergoing spine surgery at a single institution from 2015–2019 was undertaken. Demographic, presenting, operative, RTP data, along with numerical rating scale (NRS) pain scores were collected. The first and full RTP time postoperatively, in addition to the following golf metrics: 18-hole rounds per month, handicap, and self-perceived effort/performance were obtained.

Results: A total of 6 golfers were included, 3 undergoing each degenerative and deformity operations. Mean age was 60 years, and 5 of 6 (83%) patients were female. All patients were self-identified, avid golfers with a mean experience of 31 years. Mean preoperative NRS back/neck pain was 9.7, which decreased to 0.8 postoperatively ($P < 0.001$). Players undergoing smaller operations (lumbar fusion/cervical laminoplasty) returned to golf sooner than patients undergoing larger deformity corrections, with a mean first RTP of 4.3 months for degenerative patients *vs.* 9.7 months among deformity patients. All patients played either the same or more rounds of golf after surgery once they reached full RTP. The handicap of all players improved after surgery to better than before surgery, except for one high-level golfer with a handicap of 9 preoperatively that went to 15 postoperatively following an extensive revision deformity reconstruction.

Conclusions: All patients returned to playing golf at or more frequently than their preoperative status. Degenerative patients returned to play sooner than deformity patients. All patients performed at a higher level after surgery, except for one high-level golfer whose handicap worsened slightly. These data provide baseline information for future prospective studies of golfers undergoing spine surgery.

Keywords: Golf; degenerative spine surgery; deformity spine surgery; sport; return-to-play

Submitted May 12, 2021. Accepted for publication Jul 23, 2021.

doi: 10.21037/jss-21-43

View this article at: <https://dx.doi.org/10.21037/jss-21-43>

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Introduction

Degenerative spine disease is a common ailment among older adults, negatively affecting quality of life and the ability to enjoy hobbies. Cervical and lumbar degeneration with concomitant neck and back pain affect approximately 60% of adults in their sixth decade of life (1,2). Quality of life associated with degenerative spine conditions is analogous to living with brain tumors and/or cancer (3), and those suffering spinal deformity have a quality of life similar to patients with blindness, emphysema, renal failure, and stroke (4). From 1988 to 2012, rates of spine surgery have increased 4-fold, with higher rates in patients ≥ 70 years (5). A similar uptick in spinal deformity surgery has been seen, with a 3.4-fold increase in patients ≥ 60 years from 2004 to 2011 (6). Understanding how degenerative and deformity spine conditions, along with associated surgical intervention, impacts quality of life in an elderly population can be of benefit to surgeons and patients.

Golf is a recreational sport enjoyed by many older individuals, with 34.2 million Americans playing golf in 2019, of which 5.3 million were ≥ 65 years (7). Older individuals ≥ 65 years also play golf 3-times more often than younger individuals aged 18–34 years, likely a byproduct of retirement (7). Golf is an excellent source of physical activity for older people and has been linked to improved cardiovascular health that likely comes from walking the course (8). Prior studies have shown that degenerative spine conditions can significantly hinder golf frequency and performance (9,10). Authors have also suggested that golf may predispose athletes to spinal injury, as lumbar spine ailments are the most common injury incurred in golfers, making up to 22–34% of all golfing injuries (11). Moreover, low handicap golfers have been shown to generate more torque throughout their swing than medium or high-handicap golfers (12). Due to the unnatural strains placed on the low back during a violent golf swing, authors have analogized golf to a “contact sport” given the high risk of spine injury (13–15). Though much research focuses on low back injury prevention in golfers (16,17), which includes swing modification, muscle conditioning, and flexibility training, few discuss the need for surgery. The ability to return to golf after spine surgery is an important factor that many patients consider when deciding to pursue surgical treatment, and little evidence exists to guide these important quality of life decisions (9,10).

Given the overlap of patients with degenerative spine disease who also enjoy recreational golf, an in-depth study

of golf after spine surgery was undertaken. While return to golf after upper and lower extremity surgery has been studied (8,18), golf participation and performance after spine surgery is understudied. Several cross-sectional survey studies provide hypothetical surgeon responses on how to manage return to golf after spine surgery (14,19); however, without primary patient data, treatment-altering conclusions cannot be made.

The objective of the current study was to provide in-depth information on how golfers fared after spine surgery. In a cohort of self-identified, avid golfers undergoing degenerative or deformity spine surgery, we sought to describe the: (I) presentation, (II) operative treatment, and (III) return-to-play (RTP) process in this population.

We present the following article in accordance with the STROBE reporting checklist (available at <https://dx.doi.org/10.21037/jss-21-43>).

Methods

Study design

A retrospective, single-institution case series of adults > 18 years undergoing degenerative or deformity spine surgery from 2015–2019 who self-identified as avid, recreational golfers was conducted. Degenerative surgery was a-priori defined as ≤ 4 level decompression and/or fusion of the cervical or lumbar spine due to degenerative pathology. Spinal deformity surgery was a-priori defined as ≥ 6 level instrumented fusion with at least one of the following radiographic criteria [Cobb angle $> 30^\circ$, sagittal vertical axis (SVA) > 5 cm, coronal vertical axis (CVA) > 3 cm, pelvic tilt (PT) of $> 25^\circ$, or thoracic kyphosis (TK) $> 60^\circ$]. All patients underwent regional X-rays or standing full-spine low dose Stereoradiograph X-rays (EOS Imaging, Paris, France). This study obtained the institution's IRB approval (IRB# AAAT3012) prior to conducting study activities, and was exempted from needing an informed consent. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

Data collection

Demographic, presentation, and operative information were collected from the electronic medical record (EMR). Preoperative and postoperative clinic notes, operative reports, relevant imaging, and anesthetic care records were reviewed, along with inpatient documentation. In addition

to a thorough EMR review, patients were contacted directly by telephone to gather the following sport-specific information: years of golf played prior to surgery, numerical rating scale (NRS) pain scores before and after surgery, time of RTP after surgery, 18-hole rounds of golf per month before and after surgery, handicap before and after surgery, and self-perceived golf effort/performance level before and after surgery. For the “effort/performance level,” athletes were asked to rate the amount of effort they could put forth given their symptoms and/or how well they were able to perform on a scale of 1–10: 1= poorest effort/performance and 10= best effort/performance. Golf handicaps were used as a metric as well, with a positive number representing number of strokes above par.

Return to play

RTP was dichotomized into two endpoints. First RTP was defined as the time point when patients returned to any golf-specific physical activity, such as the driving range or practice rounds. Full RTP was defined as the time point when patients were no longer limited by their pathology and/or surgery and could play a full round of golf uninhibited. In addition, four total time points were assessed: (I) pre-pathology: time before any symptoms developed; (II) mid-pathology: time when symptoms were at worst prior to surgery; (III) First RTP: (defined above), and (IV) Full RTP: (defined above).

In terms of postoperative recovery practices, specific instructions were given to both cervical degenerative, lumbar degenerative and deformity patients. Cervical fusions were cleared to pitch/putt with a hard collar after 6 weeks, with full return to golf after 3 months. Lumbar fusion patients were cleared to pitch/putt at 3 months, with full return to golf after 6 months. Deformity patients were similarly cleared to pitch/putt at 3 months, with a more conservative full return to golf in the 6–12 months range depending on the extent of surgery, the patient’s comfort level, and their overall recovery. Throughout the recovery process and with all return to physical activity, patients were counseled to listen to their body, and if they had significant pain with any movement, to limit that amount of activity. Specific to golf, patients were counseled to be mindful during their full swing for excessive twisting of the lower trunk and when bending down to pick-up the ball or place it on a tee, to bend with their hips/knees rather than their lower back.

Statistical analysis

Descriptive statistics were used to summarize each patient’s course. Categorical data were presented using frequencies and percentages, while continuous data were presented as means and standard deviations (SD). Due to the small sample size of 6 patients, minimal statistical analysis was performed. Student’s *t*-tests were used to assess changes in NRS pain scores before and after surgery. All statistical analyses were performed in STATA version 14 (StataCorp LP, College Station, Texas, USA).

Results

Presentation and operative treatment

Among 6 golfers undergoing degenerative or deformity spine surgery, mean age was 60 years, and 5 of 6 (83%) patients were female (*Table 1*). All patients were self-identified, avid golfers with a mean experience of 31 years, except for Patient 3 who started later in life and had 9 years of experience. Three patients underwent degenerative surgery (Patients 1–3), while three patients underwent deformity surgery (Patients 4–6). Patients underwent a mean of 9.7 years of non-operative treatment prior to pursuing surgery. Operations ranged from single-level open transforaminal lumbar interbody fusion (TLIF) fusion (Patients 1 & 3), cervical laminoplasty (Patient 2), to larger deformity operations, including cervical and lumbar decompression and kyphosis correction (Patient 3), and thoracolumbar deformity correction (Patients 5 & 6). Patient 4 underwent 3 total planned operations: anterior cervical discectomy and fusion (ACDF), posterior cervical decompression and fusion, and posterior lumbar fusion, done over a 2.5-month period (11/16/2015–1/26/2016). All other patients underwent a single-stage operation. Of note Patient 4 underwent 1 unplanned reoperation due to new left iliopsoas weakness after the lumbar decompression/fusion due to increased lordosis at L2/3 causing retrolisthesis and narrowing of the left L2/3 and L3/4 foramen, which required revision bilateral laminotomies at L2/3 and L3/4 on postoperative day 3. Additionally, Patient 5 had a cerebrospinal fluid (CSF) leak that required reoperation at 5 weeks postoperative.

Postoperative course

Preoperative and postoperative NRS pain scores are

Table 1 Preoperative, operative, and postoperative information

Pathology	Degenerative			Deformity		
	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6
Follow-up time	5 years	5 years	4 years	5 years	2 years	1.3 years
Age/sex	48/F	55/M	67/F	69/F	61/F	66/F
Golf experience (years)	28	40	9	62	20	25
Diagnosis	Lumbar stenosis; focal kyphosis	Cervical myeloradiculopathy	Lumbar stenosis	Cervical myeloradiculopathy; flat back syndrome, lumbar stenosis	Coronal and sagittal malalignment	Rigid thoracic hyperkyphosis, lumbar scoliosis
Length of non-surgical treatment (years)	20	5	12	2	8	11
Preop NRS Pain Score	Back 8 Leg 9	Neck 10 Arm 10	Back 6 Leg 10	Back 10; neck 8 Leg 8; arm 7	Back 8 Leg 0	Back 6 Leg 0
Postop NRS Pain Score	Back 1 Leg 2	Neck 0 Arm 0	Back 0 Leg 1	Back 0; neck 0 Leg 0; arm 0	Back 0 Leg 0	Back 4 Leg 0
Operation	L4/5 open TLIF	C3-7 laminoplasty	L4/5 open TLIF	ACDF C2-T1; posterior cervical fusion C2-T1; L1-pelvis decompression/fusion	T3-pelvis deformity correction, PCOs T10-S1, L5/S1 TLIF w/kickstand rod	T2-pelvis deformity correction, L4/5 and L5/S1 TLIF, L3-S1 PCOs
First RTP (months)	5	2	6	15	8	6
Full RTP (months)	6	2	18	42	18	10

NRS, numerical rating scale; ACDF, anterior cervical discectomy and fusion; RTP, return-to-play; TLIF, transforaminal lumbar interbody fusion; PCO, posterior column osteotomy.

provided, at a mean follow-up of 3.7 years (*Table 1*). Mean preoperative NRS back/neck pain was 9.7, which decreased to 0.8 postoperatively ($P < 0.001$). Mean preoperative NRS leg/arm pain was 6.2, which decreased to 0.5 postoperatively ($P < 0.001$). Compared to the degenerative lumbar patients, the two thoracolumbar deformity patients had no leg pain preoperatively or postoperatively, but endorsed significant preoperative back pain secondary to their deformity.

Return to play

Not surprisingly, players undergoing smaller operations (lumbar fusion/laminoplasty) returned to golf sooner than patients undergoing larger deformity corrections, with a mean first RTP of 4.3 months for degenerative patients vs. 9.7 months among deformity patients (*Table 1*; *Figure 1*). With respect to full RTP, averages are not presented due to 2 patients that were outliers. Among the 3 degenerative patients, Patients 1 and 2 returned to golf fully by 6 and

2 months, respectively; however, Patient 3 had a prolonged return at 18 months. Among deformity patients, Patients 5 and 6 returned by 18 and 10 months, yet Patient 4 had a prolonged return at 42 months, though this patient underwent 4 total operations over a 2.5-month period.

Golf performance

Prior to surgery, several patients found many aspects of golf difficult, which included bunker play, long irons, and driving (*Table 2*). In addition, 3 patients endorsed that “everything” was difficult right before they needed surgery. Regarding frequency of 18-hole rounds per month, all patients played either the same or more rounds of golf after surgery once they reached full RTP (*Table 2*; *Figure 2*). Of note, the only patients that did not play more rounds per month after surgery were Patients 2 and 6, who were high-level golfers already playing 15 and 20 rounds per month, respectively, before surgery. They each returned to their preoperative

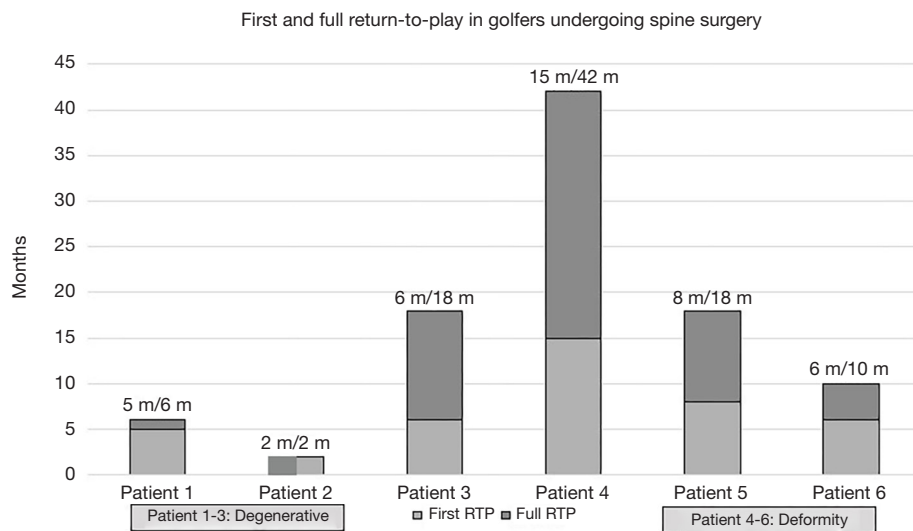


Figure 1 First and full return-to-play in golfers undergoing spine surgery.

Table 2 Golf-specific information

Pathology	Degenerative			Deformity		
	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6
Most difficult part of golf prior to surgery	Bunker play; long irons	All aspects of game; “couldn’t golf at all”	All aspects of game; “could no longer walk the course”	“Everything except putting”	Driving off the tee	All aspects of game
Rounds of 18-hole rounds of golf per month, <i>Pre-pathology/ Mid-pathology/1st RTP/Full RTP</i>	2/4/6/10	15/0/15/15	0/2/2/6	3/0/3/12	3/0/2/10	20/15/8/20
More golf after surgery?	Yes	Same	Yes	Yes	Yes	Same
Handicap, <i>Pre-pathology/ Mid-pathology/1stRTP/Full RTP</i>	22/8/8/6	5/NA/5/5	NA/NA/NA/25	15/NA/NA/15	30/NA/30/25	9/13/15/15
Self-perceived effort/performance level, <i>Pre-pathology/ Mid-pathology/1st RTP/Full RTP</i>	10/4/6/8	10/1/10/10	10/3/8/10	10/1/5/10	10/1/6/10	10/7/5/9
Better performance after surgery?	Yes	Same	NA	Same	Yes	No
Approximate 18-hole round score	102/90/85/80	77/NA/79/79	NA/NA/NA/93	90/NA/98/90	123/NA/120/100	78/85/95/92

RTP, Return to Play; NA, not applicable; Pre-pathology: time before any symptoms developed; Mid-pathology: time when symptoms were at worst prior to surgery; First RTP: time point when patients returned to any golf-specific physical activity; Full RTP: time point when patients were no longer limited by their pathology and/or surgery and could play a full round of golf uninhibited.

frequency of rounds per month.

In terms of performance, the handicap of all players improved after surgery to better than before surgery, except for one high-level golfer (Table 2; Figure 3). Patient 6 was scoring in the high 70s with a 9 handicap before her spinal deformity correction, yet was not able to return to

this high-level of performance, and postoperatively had a handicap of 15, although she also had the shortest follow-up of all 6 patients and could potentially improve with time. Of note, Patient 3 took up golf more seriously postoperatively and was unable to compute a handicap until after full RTP.

With respect to self-perceived effort/performance level,

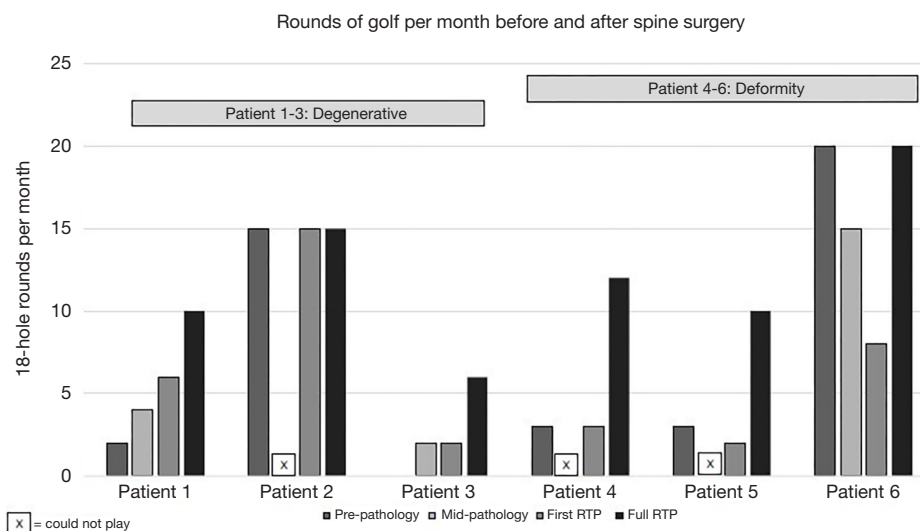


Figure 2 Rounds of golf per month before and after spine surgery.

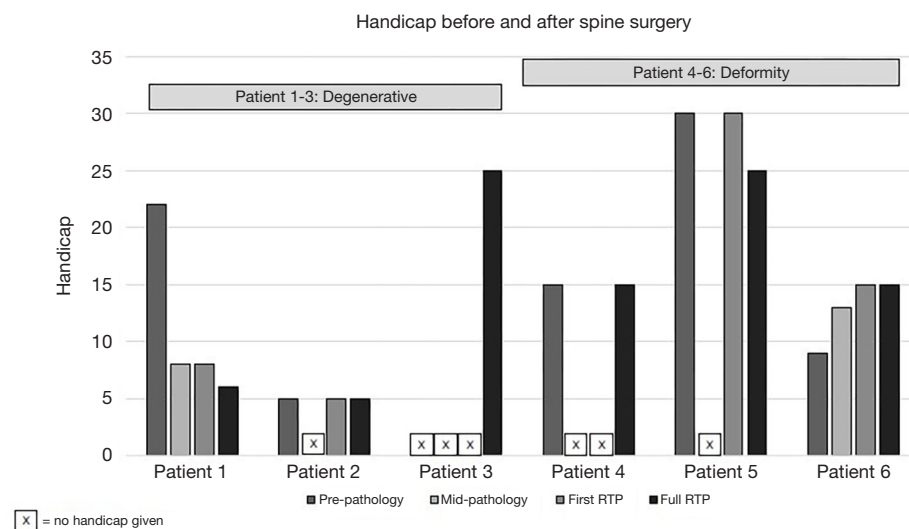


Figure 3 Handicap before and after spine surgery.

prior to surgery patients were performing at a mean of 2.8 of their prior maximal effort/performance levels. After surgery, patients rated their own performance at a mean of 9.5 after full RTP ($P < 0.001$) (Table 2). Representative deformity patients are summarized in Figures 4-6.

Discussion

The current pilot study sought to conduct an in-depth investigation of how patients return to golf after

undergoing degenerative and deformity spine surgery. In 6 patients with a mean golfing experience of over 3 decades, all patients were able to return to playing golf at or more frequently than their preoperative status. Pain scores improved significantly in all patients at a mean follow-up of 3.7 years. As expected, degenerative patients returned sooner than deformity patients. All patients performed at a higher level after surgery, except for one high-level golfer whose handicap dropped slightly. Though this represents a preliminary study that requires replication in larger samples,

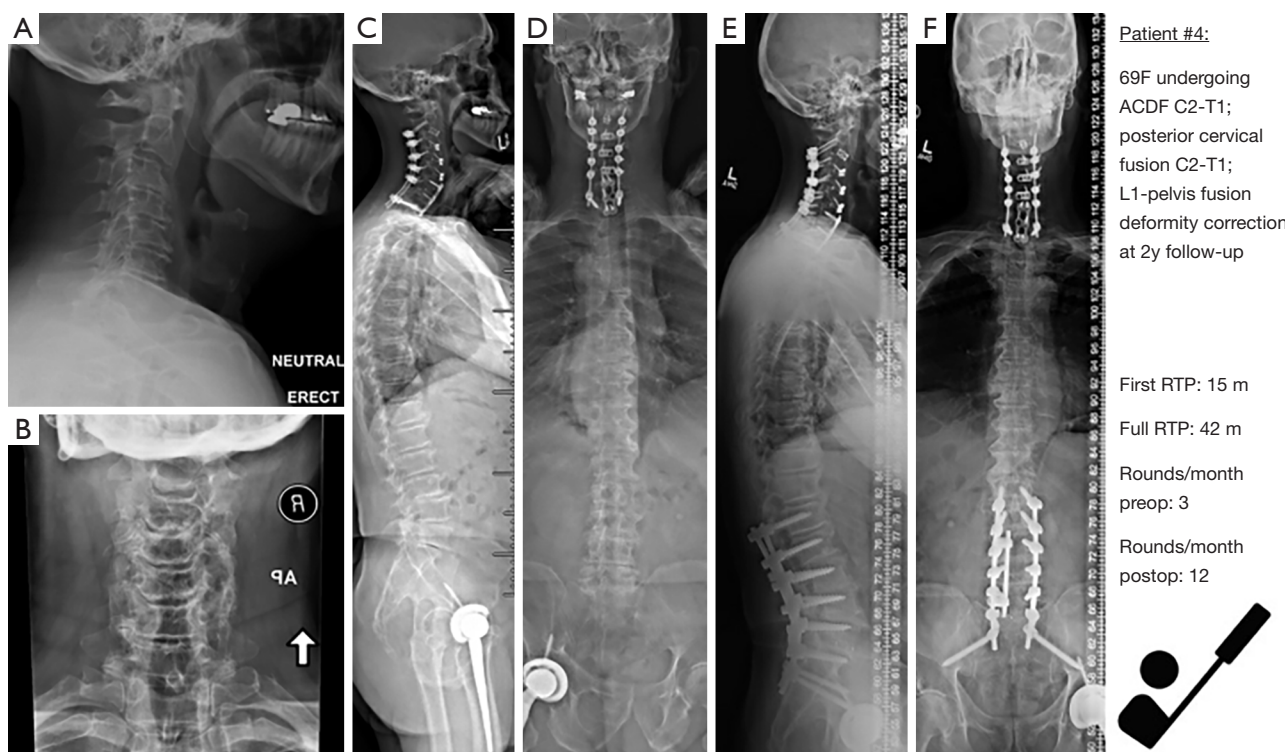


Figure 4 Patient #4 was a 69-year-old female with cervical kyphosis, multilevel central and foraminal (A,B). She first underwent a staged anterior/posterior cervical fusion consisting of ACDF C2-T1 and posterior cervical fusion C2-T1 (C,D), with restoration of her cervical lordosis. Months later, she underwent an L1-pelvis decompression/fusion (E,F).

it is our hope these early data can help surgeons and patients improve their understanding about return to golf after spine surgery and lead to larger, multi-institutional studies.

Though much has been written about golf after spine surgery, most studies lack primary data and instead report survey results or summarize existing data. Abla and colleagues (19) surveyed 523 spine surgeons about return to golf practices after common spine operations, such as lumbar decompression/fusion and ACDF. The majority of surgeons recommended a RTP time of 4–8 weeks after lumbar decompression, 2–3 months after ACDF, and 6 months after lumbar fusion. The authors also queried surgeons based on hypothetical, representative patients—retired male avid golfer, retired female weekend golfer, working male occasional golfer, collegiate golfer, and female professional golfer—and a shorter RTP was recommended for more competitive golfers. Though a useful survey study, no primary patient information was included, and only degenerative operations were discussed. In another review by Haddas *et al.* (14), the authors adequately summarized how to protect lumbar spine musculature while golfing,

useful stretching techniques, and ways to maintain lumbar flexibility. The authors also asserted a void in the literature regarding RTP protocols and postoperative rehabilitation protocols for golfers undergoing lumbar spine surgery, particularly in those with high impact swings (14). The remaining literature presented discussed RTP in all sports, without mention of golf-specific studies. Again, no primary patient data was presented.

The 3 patients undergoing degenerative surgery in our study all first returned to golf in under 6 months, and 2 of 3 patients returned fully at 6 months. To our knowledge, only two studies have provided primary data on RTP in golfers after spine surgery. In a study of 34 patients undergoing elective cervical spine surgery only, Richards *et al.* (9) reported that 71% endorsed a decrease in golf ability due to their spine condition, and 68% successfully returned to golf postoperatively. Interestingly, 57% played the same amount or more after surgery, while 43% played less after surgery, which is in contrast to our results, where 100% of patients played the same or more postoperatively. In terms of performance, they reported 65% of patients played at

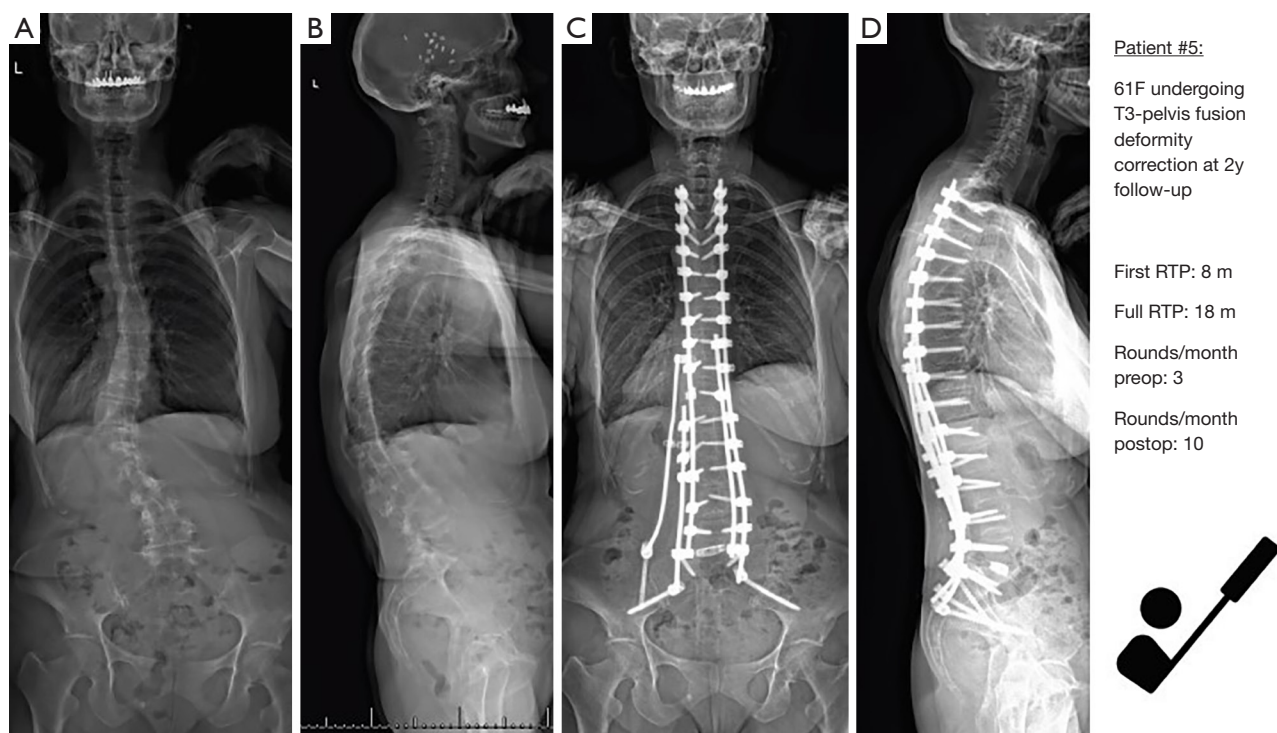


Figure 5 Patient #5 was a 61-year-old female with several years of degenerative thoracolumbar and lumbosacral scoliosis. She had a coronal malalignment of 5.5 cm to the left and thoracolumbar kyphosis of 60.1° (A,B). She underwent a T3-pelvis fusion with posterior column-osteotomies (PCOs) from T10-S1 with an L5/S1 TLIF and kickstand rod placed. Postoperatively her coronal alignment improved to 1.3 cm and thoracolumbar kyphosis reduced to 33.2° (C,D).

the same or higher level after surgery, (9) contrary to our results, where all but one high-level golfer performed the same or better postoperatively. RTP time was >12 months in 40% of patients, also longer than our cohort of 3 patients. The second study by Shifflett and colleagues (10) surveyed 34 golfers undergoing 1 or 2-level degenerative lumbar spine fusion, including open posterior fusion (50%), anterior lumbar fusion (35%), and minimally invasive TLIF (15%). In 79% of golfers, back/leg pain negatively affected their ability to play golf, and by 1-year, 65% of patients returned to practice and 52% returned to course play (10). With respect to postoperative performance, 77% played the same amount or more postoperatively, and 80% reported the same or improved handicap (10). Unfortunately, postoperative follow-up did not extend past 1-year, thus we do not know the true rates of RTP. Interestingly, 9% of patients engaged in some sort of golf-specific rehabilitation, and the biggest decrease on their golf performance was driving distance in 50% of patients, while accuracy suffered only in 9%. Overall, the second study of degenerative lumbar fusion patients fits with

the current data.

Patients undergoing cervical and thoracolumbar deformity correction each returned to golf successfully, albeit at a later time than degenerative patients. Among the existing literature of return to golf after spine surgery, only degenerative operations are discussed, without mention of larger spinal deformity reconstructions. Contrary to what most patients and surgeons may think, our results show that return to golf is possible after spinal deformity correction. The only data on RTP in deformity patients is limited to adolescent idiopathic scoliosis (AIS) patients, where approximately 50% of AIS patients returned to sports by 6-month. However, golf specifically was not mentioned, and adolescents bear little resemblance to adult deformity populations (20,21). One adult study assessed patient's preoperative goals after deformity surgery and found that 37 of 59 patients (63%) stated that exercise or sport was a desired postoperative activity, but specific sports were not mentioned. To our knowledge, the return to golf data in the three deformity patients presented here may be some of the

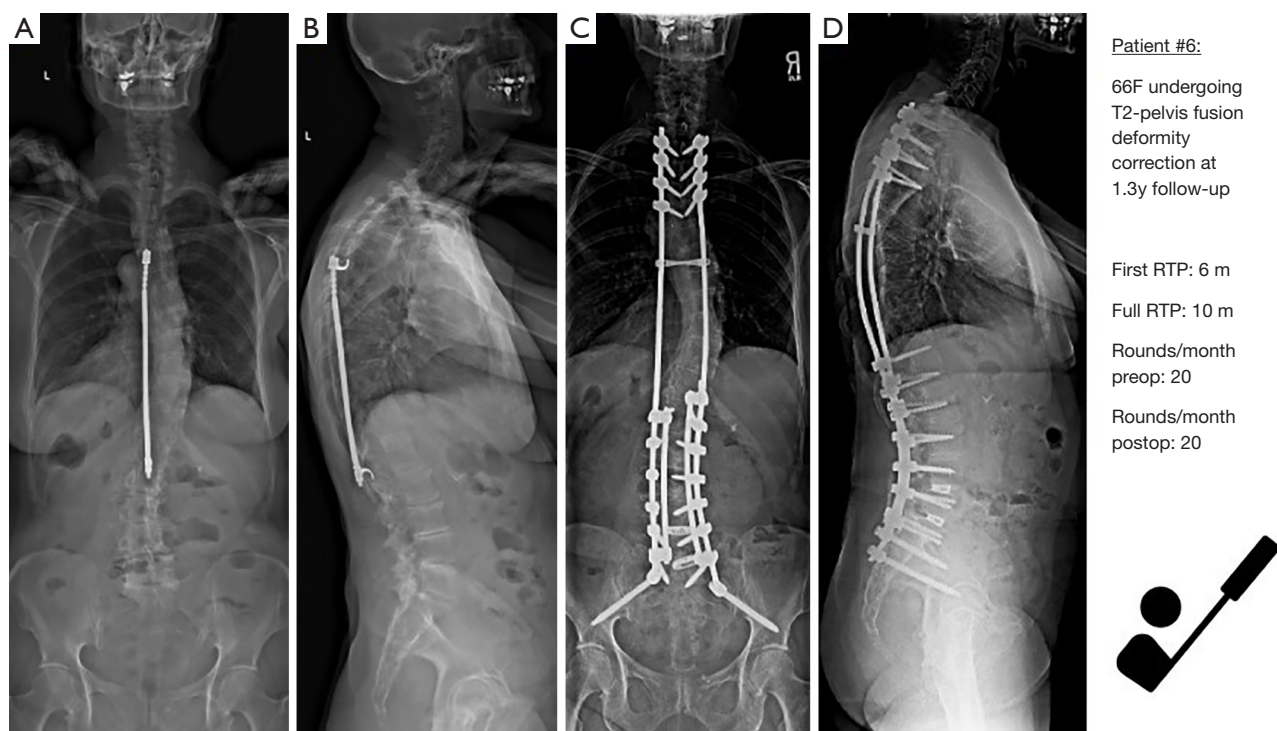


Figure 6 Patient #6 was a 66-year-old female with prior Harrington rod placed when she was a teenager. Since then, under distal lumbar spine had degenerated significantly with increasing kyphosis above her prior fusion. She had distal lumbar degenerative scoliosis as well as lumbar spinal stenosis at L4-5, in addition to proximal junctional kyphosis of 40° above her fusion (A,B). She underwent an extension of her fusion from T2-sacrum, with instrumentation to the pelvis, with L4/5 and L5/S1 TLIF, L3-S1 PCOs, and reduction of her proximal thoracic kyphosis (C,D).

few, if any, currently presented in the literature.

It is our hope this data can be used to counsel patients undergoing spine surgery on their postoperative return to golf. Based on the initial results of our limited case series, we recommend golf practices be studied across multiple institutions in a more systematic and prospective manner. Instead of retrospectively asking patients to report golf practices, obtaining a larger sample of all types of golfers, those who play frequently and infrequently, will help us better understand the impact of surgery on the novice golfer. Moreover, engaging with sport-specific physical therapists may also assist with the RTP process.

The current study is not without limitation. The most important weakness is the small sample size of six patients. We strongly caution against applying these data to large populations, as this is a small, retrospective sample of patients undergoing spine surgery. We attempted to counteract this limitation by obtaining in-depth information on preoperative and postoperative golf practices. It would be inappropriate to apply the results of these six patients

to all patients undergoing degenerative and deformity spinal surgery; rather, these results can be viewed as preliminary findings from a small sample that can help patients better understand their postoperative recovery. Second, all data are self-reported, without confirmation of actual playing practices. It is possible that rounds per month or handicaps may have been higher or lower than provided. Third, we included patients who self-identified as avid golfers, and it is entirely possible we did not capture patients who played recreationally and did not mention this to their spine surgeon. Moreover, it is possible these recreational golfers were not able to RTP successfully, and this information may have been missed. Thus, we caution against overinterpretation of this small sample. We very much view this study as a pilot analysis to be replicated prospectively across multiple institutions, with additional questions included such as range of mobility, area of game impacted most (driving, irons, putting), disadvantageous golfing behaviors during the early and late recovery periods, and walking the course versus driving in a golf cart.

Conclusions

In 6 self-identified, avid golfers undergoing degenerative or deformity spine surgery with a mean follow-up of 3.7 years, all were able to return to playing golf at or more frequently than their preoperative status. Pain scores improved significantly in all patients. Degenerative patients returned to golf sooner than deformity patients, and all patients performed at a higher level after surgery, except for one high-level golfer whose handicap worsened slightly. These data provide baseline information for future, prospective studies enrolling all patients of golf skill level and playing frequency to learn more about golf after spine surgery.

Acknowledgments

Funding: None.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at <https://dx.doi.org/10.21037/jss-21-43>

Data Sharing Statement: Available at <https://dx.doi.org/10.21037/jss-21-43>

Peer Review File: Available at <https://dx.doi.org/10.21037/jss-21-43>

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://dx.doi.org/10.21037/jss-21-43>). LGL reports personal fees from Medtronic, grants and personal fees from DePuy-Synthes Spine, personal fees from K2M, non-financial support from Broadwater, non-financial support from Seattle Science Foundation, grants and non-financial support from Scoliosis Research Society, non-financial support from Stryker Spine, non-financial support from The Spinal Research Foundation, grants from EOS, grants from Setting Scoliosis Straight Foundation, personal fees from Fox Rothschild, LLC, personal fees from Quality Medical Publishing, other from Evans Family Donation, other from Fox Family Foundation, grants and non-financial support from AOSpine, outside the submitted work. LGL serves as an unpaid editorial board member of *Journal of Spine Surgery* from Oct 2019 to Oct 2021. RAL reports consultant/royalty fees from Medtronic, research grants

from Department of Defense, outside the submitted work. Dr. KDR reports royalties from Biomet, consulting fees from Nuvasive, and Happe Spine, stock or stock options from Axiomed, Expanding Orthopedics, Spineology, Spinal Kinetics, Amedica, Vertiflex, Benevenue, and Paradigm Spine, outside the submitted work. SZ serves as an unpaid editorial board member of *Journal of Spine Surgery*. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study has obtained the institution's IRB approval prior to conducting study activities, and was exempted from needing an informed consent. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

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Cite this article as: Zuckerman SL, Gillespie A, Kerolus MG, Buchanan IA, Ha AS, Cerpa M, Leung E, Riew KD, Lenke LG, Lehman RA Jr. Return to golf after adult degenerative and deformity spine surgery: a preliminary case series of how surgery impacts golf play and performance. *J Spine Surg* 2021;7(3):289-299. doi: 10.21037/jss-21-43