Effects of Injuries on a Pitcher's Performance

Braxton Reynolds, Olivia Miles, Scott Lehrfeld, and Maddy Fay

Wharton Moneyball Academy 2018, Sports Analytics Student Research Journal

• Project Question

- What is the impact of Tommy John surgery and rotator cuff injuries on ERA in pitchers from 2003 2017?
 - We will compare ERA after recovery to pre-injury ERA to determine how significant the impact of the injury and recovery was
- Research Hypothesis
 - Injuries (Tommy John Surgery and Rotator Cuff Injuries) significantly increase the ERA of most injured pitchers

• Null Hypothesis

• The aforementioned injuries do not significantly increase most players' performance



UCL Reconstruction: Background

• UCL Injury

 The ulnar collateral ligament (UCL) is a structure that supports the relationship between the humerus and the ulna. This ligament can be injured in throwing sports.

• Tommy John

- Injured UCL and had UCL Reconstruction surgery in 1974
- *Returned to Majors in 1976 season and continued his career with 14 more seasons*
- Surgery became more common and is now used for many MLB players that stretch, fray, or tear their UCL



Many think that a surgery as catastrophic as Tommy John is devastating...



Pictured: Sad Wilmer Flores

... but the statistics say otherwise!!!



Pictured: Happy Odubel Herrera

Tommy John Surgery: Data

- 168 sample size
- Surgeries occurred in 2003-2017
- 20 innings pitched needed to qualify



TJ_Surgery_Date	Throws	Age	Pre_Injury_ERA	Post_Injury_ERA
2003	R	38	3.73	8.68
2003	L	23	5.24	6.1
2003	R	22	5.03	4.76
2003	R	27	4.69	6.4
2003	R	25	4.5	6.08
2003	R	26	5.01	3.9
2003	R	22	5.35	5.47
2003	R	27	3.28	7.5
2003	R	34	5.19	6.85
2003	R	31	4.57	5.09
2003	R	26	3.86	4.02
2003	R	27	4.74	4.01
2004	R	26	4.74	5.26
2004	R	28	2.98	5.43
	TJ_Surgery_Date 2003 2004 2004	TJ_Surgery_Date Throws 2003 R 2004 R 2005 R	TJ_Surgery_Date Throws Age 2003 R 38 2003 L 23 2003 R 22 2003 R 27 2003 R 25 2003 R 26 2003 R 26 2003 R 26 2003 R 26 2003 R 27 2003 R 34 2003 R 34 2003 R 31 2003 R 32 2003 R 32 2003 R 32 2003 </td <td>TJ_Surgery_DateThrowsAgePre_Injury_ERA2003R383.7.32003L235.242003R225.032003R274.692003R265.012003R265.012003R265.012003R275.352003R273.282003R345.192003R345.192003R263.862003R263.862003R264.742004R264.742004R282.98</td>	TJ_Surgery_DateThrowsAgePre_Injury_ERA2003R383.7.32003L235.242003R225.032003R274.692003R265.012003R265.012003R265.012003R275.352003R273.282003R345.192003R345.192003R263.862003R263.862003R264.742004R264.742004R282.98

Tommy John Surgery: Pre-TJ Contingency Table

Pre Tommy John Surgery

Count Total %	Age < 26	26-30	Age >= 31	Total
ERA < 4	24	32	17	73
	14.29	19.05	10.12	43.45
4 <= ERA < 8	25	48	21	94
	14.88	28.57	12.5	55.95
ERA >= 8	1	0	0	1
	0.60	0	0	0.60
Total	50 29.76	80 47.62	38 22.62	168

Tommy John Surgery: Post-TJ Contingency Table

Post Tommy John Surgery

Count Total%	Age < 26	26-30	Age >= 31	Total
ERA < 4	14	33	14	61
	8.33	19.64	8.33	36.30
4 <= ERA < 8	33	44	23	100
	19.64	26.19	13.69	59.52
ERA >= 8	3	3	1	7
	1.79	1.79	0.60	4.18
Total	50 29.76	80 47.62	38 22.62	168

Tommy John Surgery: ERA Scatter



Tommy John Surgery: ERA Histograms

Pre Injury ERA

20 count 10-0-2 4 6 8 Pre Injury ERA

15 tuno ¹⁰-5-0-3 9 6

Post Injury ERA

Post Injury ERA



Rotator Cuff Injury: Background

- The **rotator cuff** is a group of muscles and tendons that surround the shoulder joint
- Rotator Cuff Tears
 - Usually caused by overuse
 - Can lead to tendon fraying, tendonitis, and tears
 - Especially affects pitchers



Rotator Cuff Injury Data

- 107 sample size
- Injury occured in 2003-2017
- 20 innings pitched needed to qualify



Name	Position	Team	Year	ERA_Before	ERA_After	
Mike Remlinger	RP	Chicago Cubs	2003	3.28	4.83	
Steve Karsay	RP	New York Yankees	2003	3.88	5.97	
Todd Ritchie	RP	Milwaukee Brewers	2003	4.66	9	
Aaron Sele	SP	Anaheim Angels	2003	4.48	5.13	
Claudio Vargas	SP	Montreal Expos	2003	4.34	4.91	
Hideo Nomo	SP	Los Angeles Dodgers	2003	3.85	7.95	
Jose Contreras	SP	New York Yankees	2003	4.85	4.65	
Orlando Hernandez	SP	Montreal Expos	2003	4.04	4.28	
Aaron Taylor	SP	Seattle Mariners	2004	8.66	9.82	
Hideo Nomo	SP	Los Angeles Dodgers	2004	3.85	7.7	
Jason Schmidt	SP	San Francisco Giants	2004	4.02	3.83	

Rotator Cuff Injury: ERA Scatter



Rotator Cuff Injury: ERA Histogram



Post-Rotator Cuff Injury Histogram

Post-Injury ERAs 2003-2016 Compared to Average ERA



Linear Regression to the Mean (both)



ERA Histogram with Distribution (both)

Tommy John Post-Injury ERA Distribution 25 -20-30 -15 -Count 20 -10-10-5 -0-0-2.5 -2.5 0.0 5.0 0 Difference in ERA Difference in ERA

Rotator Cuff Post-Injury ERA Distribution

False Cause Fallacy

- False Cause Fallacy assuming association means causation
 - While our data suggests that the injuries did not raise the ERAs dramatically, there are a variety of other factors that could have also contributed to this:
 - Player Age
 - Player Overall Health
 - Length of Rehab Time
 - Player Return (or lack thereof)
 - etc.

It is important to recognize that these factors exist, and that the research is biased, but the large sample size and the detailed analysis decrease the impact of these other factors.

Confounding Variables

- **Confounding Variable** *something else that can explain the changes observed*
 - There are a few possible confounding variables as well:
 - Age Curves
 - Surgery Advancements
 - Surgery Success Rates
 - Data Filtering
 - Did not include players who pitched less than 20 innings
 - Did not remove the 275 injured players from the 10,075 pitcher control group

However, these factors are not likely to play a tremendous role in the changes observed, as the injuries directly cause the ERA changes.

In Conclusion...

• The research hypothesis is wrong and the null is correct neither injury and subsequent rehab heavily impacts the ERA of most injured players