Ulnar Collateral Ligament Injury Epidemic: Causes and Prevention

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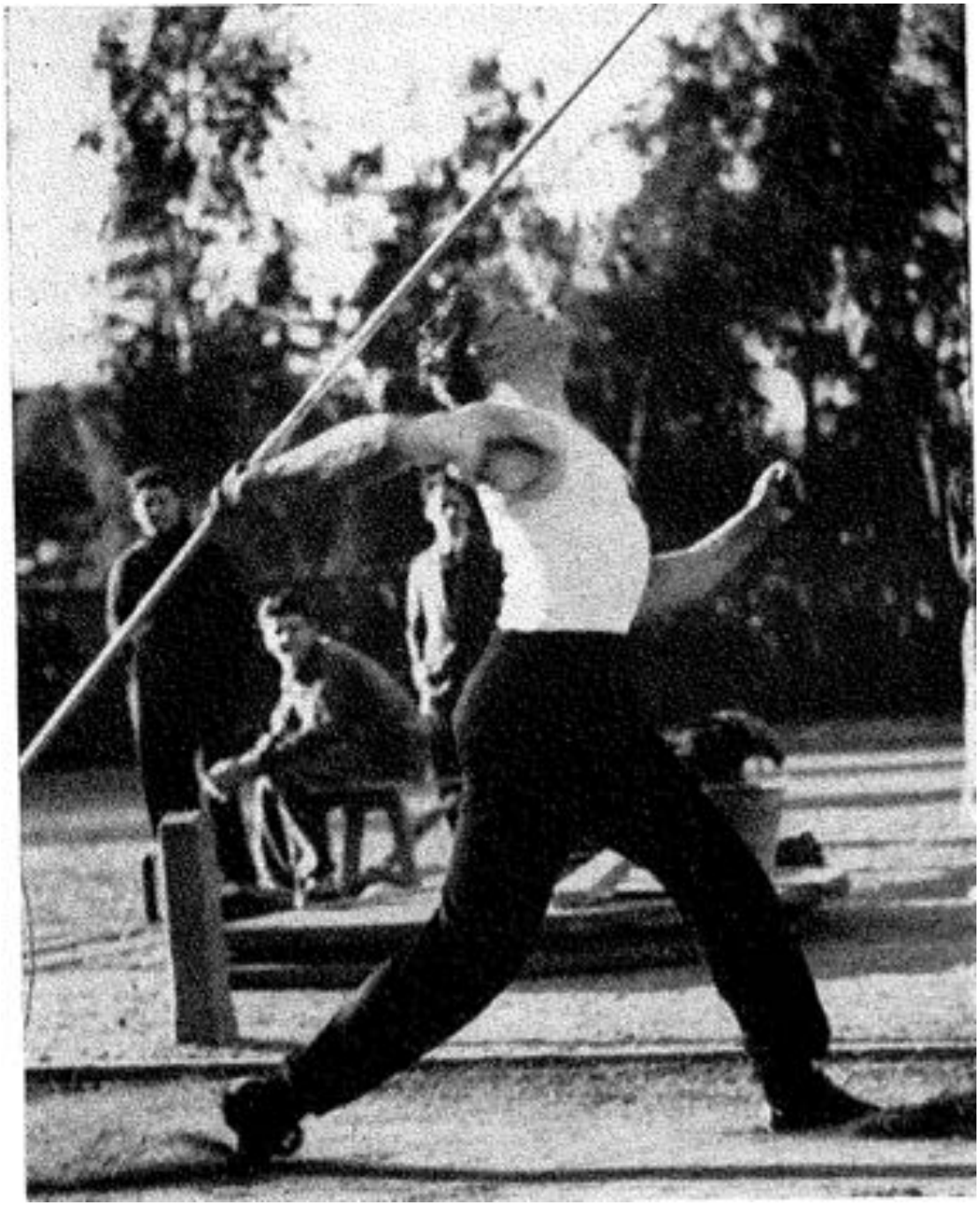
- 1946: Waris: UCL injuries in Javelin Throwers



Waris W. Elbow injuries of javelin-throwers. Acta Chir Scand. 1946;93(6):563-575.

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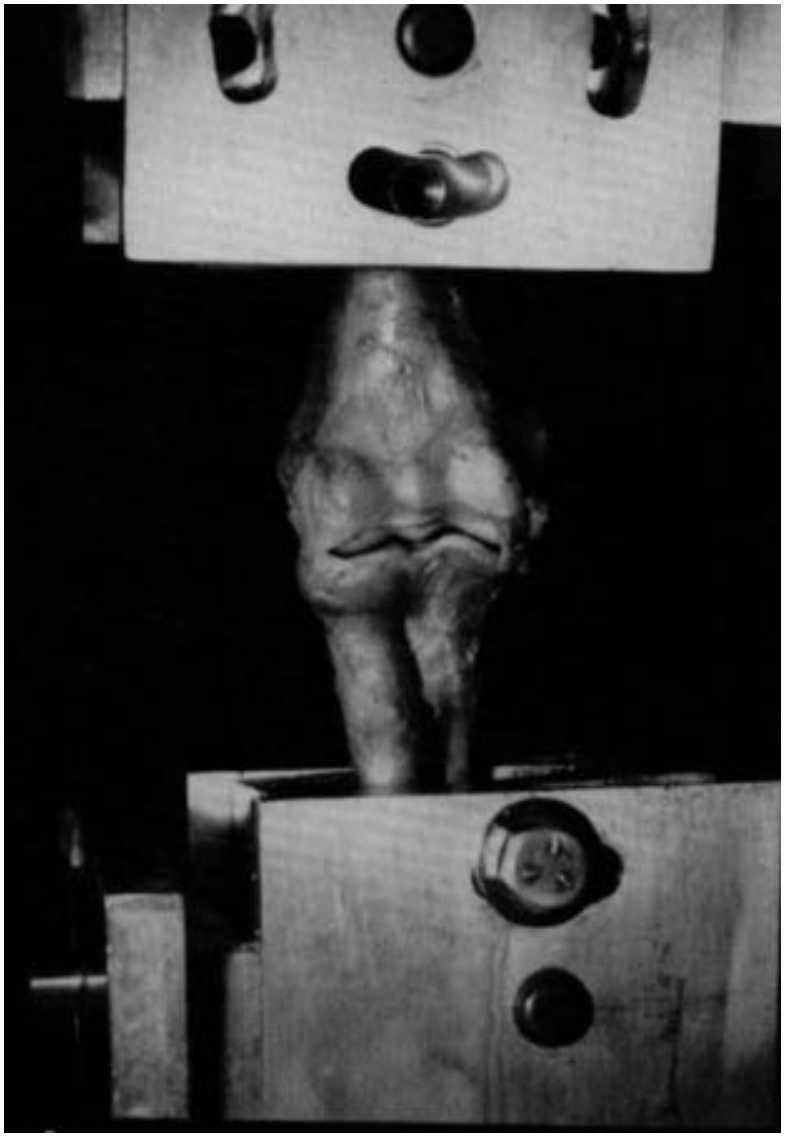

Morrey BF, An KN. Articular and ligamentous contributions to the stability of the elbow joint. *Am J Sports Med*. 1983;11(5):315-319.

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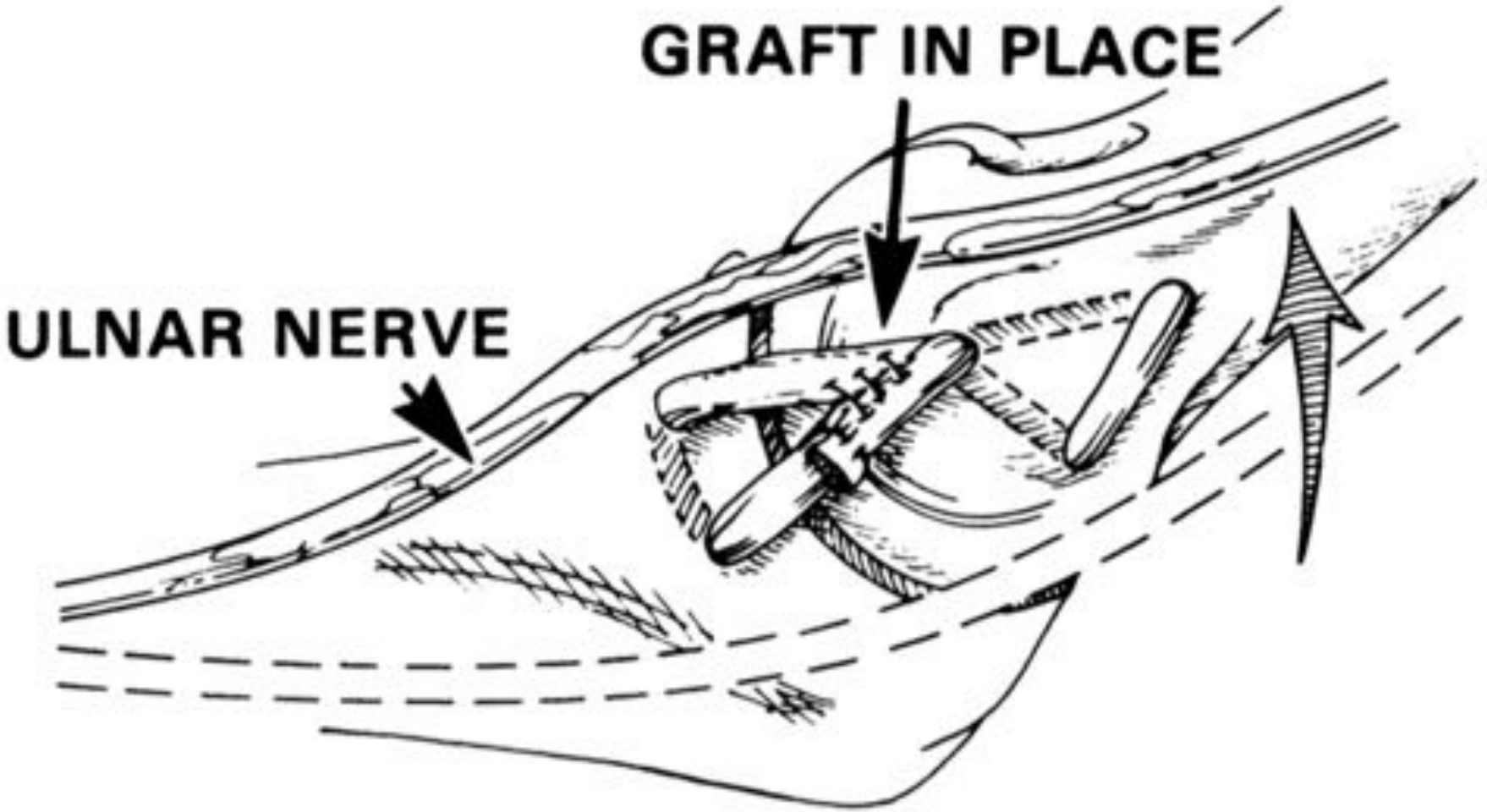

Jobe FW, Stark H, Lombardo SJ. Reconstruction of the ulnar collateral ligament in athletes. *J Bone Joint Surg Am*. 1986;68(8):1158-1163.

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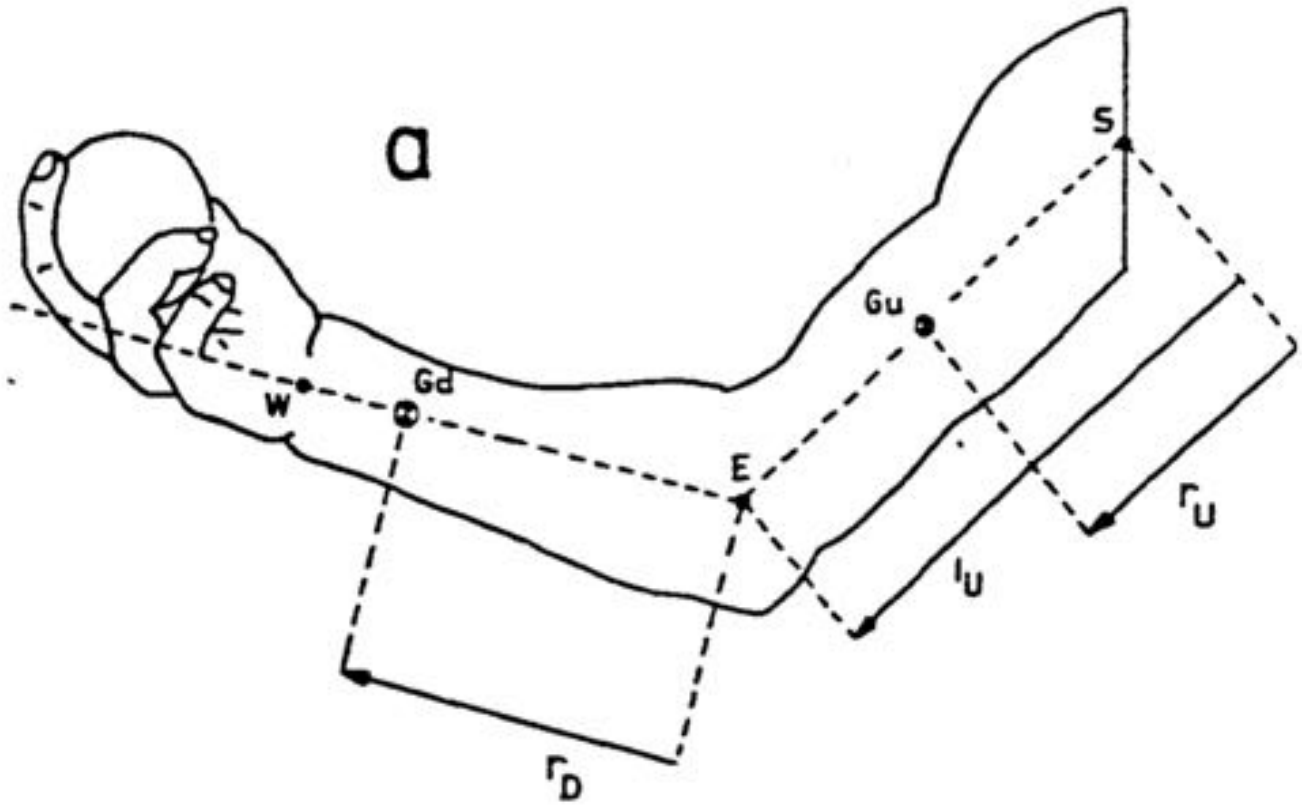

Feltner ME, Dapena J. Three-dimensional interactions in a two-segment kinetic chain. Part 1; General model. *International Journal of Sports Biomechanics*. 1989;5:403-419.

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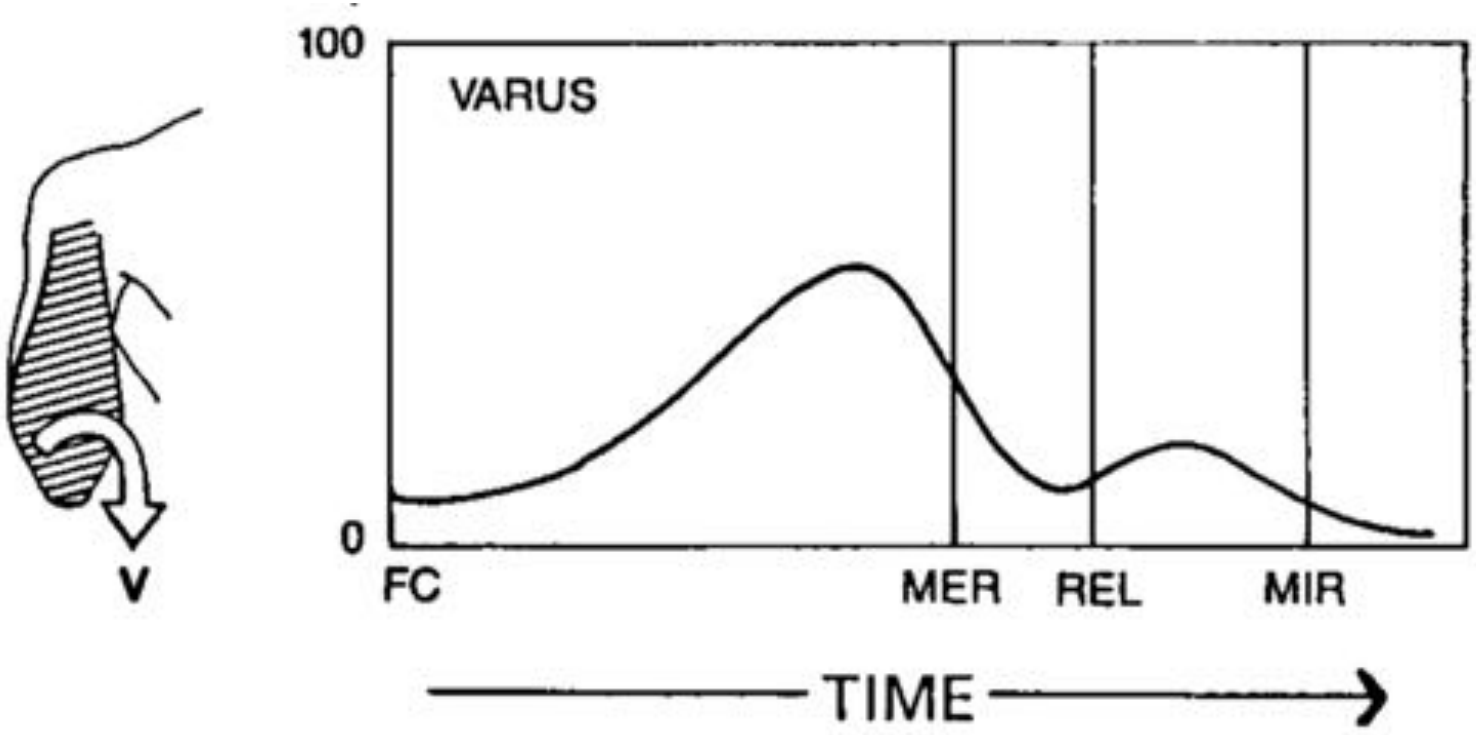

Fleisig GS, Andrews JR, Dillman CJ, Escamilla RF. Kinetics of Baseball Pitching with Implications About Injury Mechanisms. *Am J Sports Med*. 1995;23(2):233-239.

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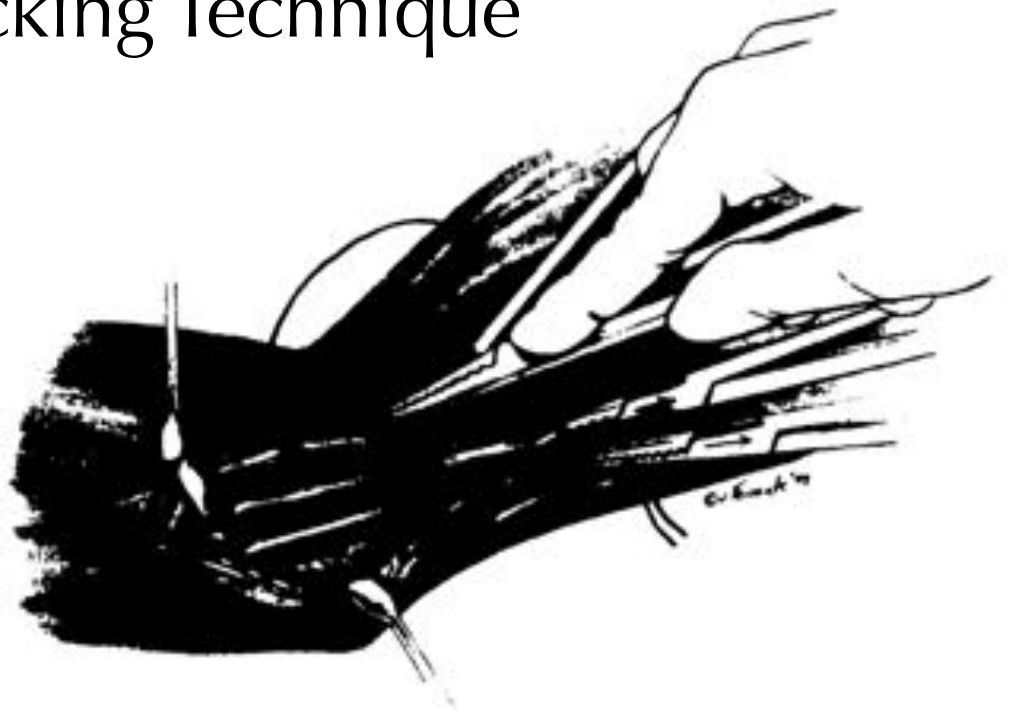
- 2000: Altchek: Docking Technique

FIG. 8. The posterior limb of the graft is docked in the humeral tunnel. The elbow is reduced with varus stress and after final tensioning of the graft, a Krackow stitch is placed in the anterior limb of the graft using a #1 Ethibond Excel OS-2 needle.



Altchek DW, Hyman J, Williams R, et al. Management of MCL injuries of the elbow in throwers. *Techniques in Shoulder & Elbow Surgery*. 2000;1(2):73-81.

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- 2002: Lyman/Fleisig: Pitch Counts

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- 1989: Feltner and
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- 2000: Altchek: Do
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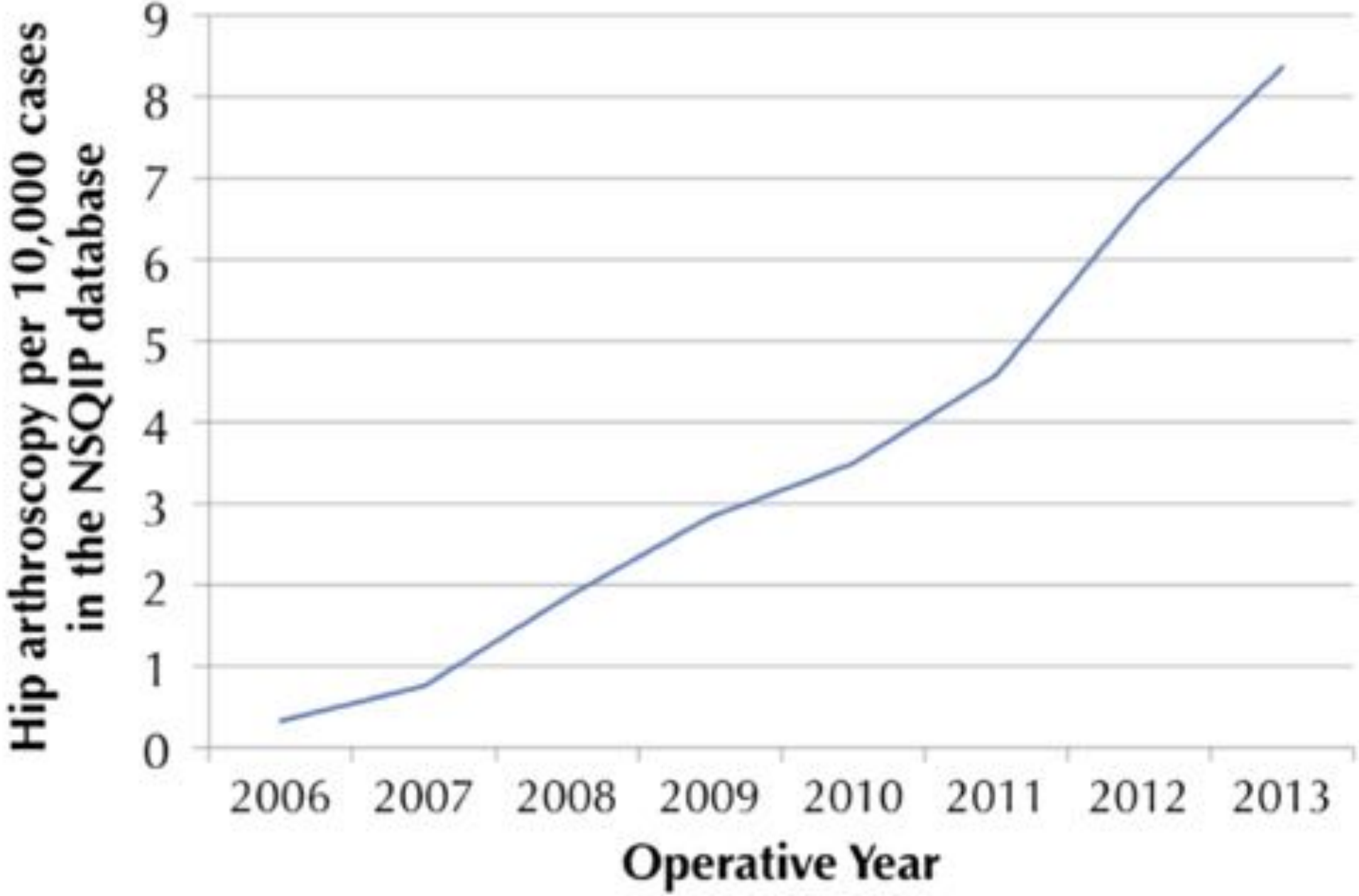
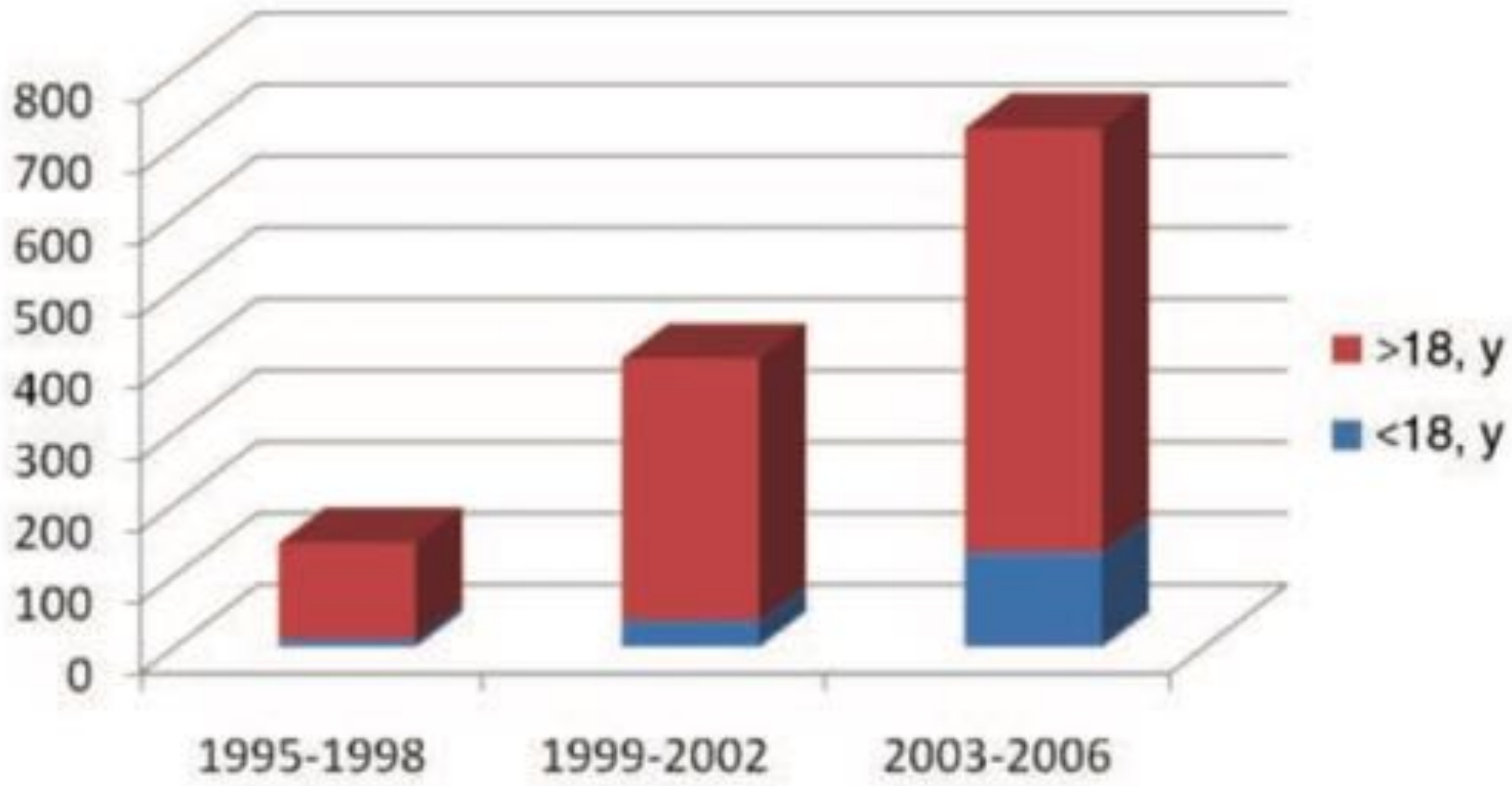
- 2004: USA Baseball
- 2007: Little League A
- 2010: Andrews: Series of 1281 UCLRs
- 2014: MLB: Pitch Smart Program
- 2016: Dugas: UCL repair

Epidemic?

- Previously unrecognized injury
- Previously untreatable injury
- Is the incidence of the injury increasing or is the incidence of the treatment increasing?



Cvetanovich GL, Chalmers PN, Levy DM, et al. Hip Arthroscopy Surgical Volume Trends and 30-Day Postoperative Complications. *Arthroscopy*. April 2016.

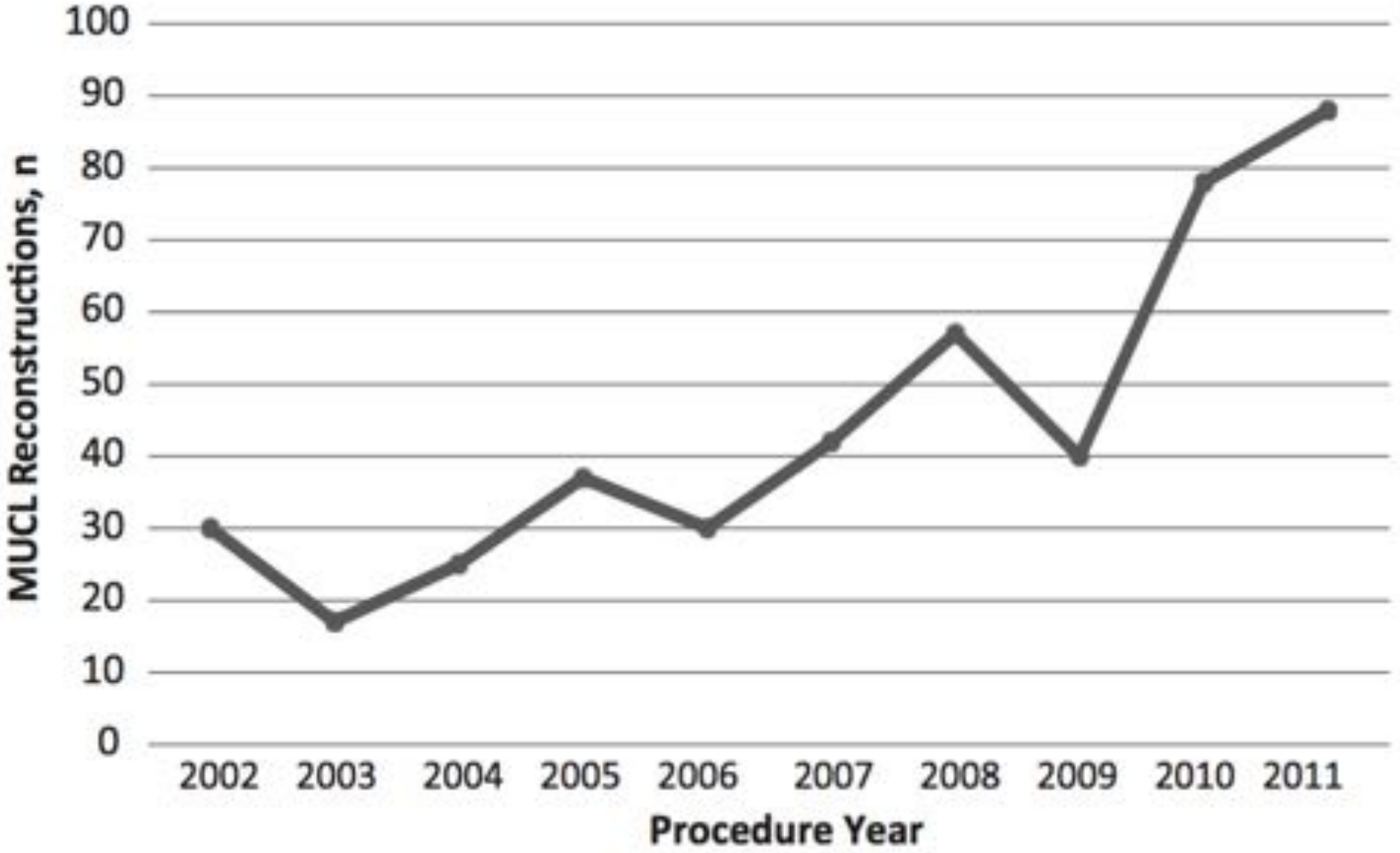


Cain EL, Andrews JR, Dugas JR, et al. Outcome of Ulnar Collateral Ligament Reconstruction of the Elbow in 1281 Athletes: Results in 743 Athletes With Minimum 2-Year Follow-up. *Am J Sports Med*. 2010;38(12):2426-2434.

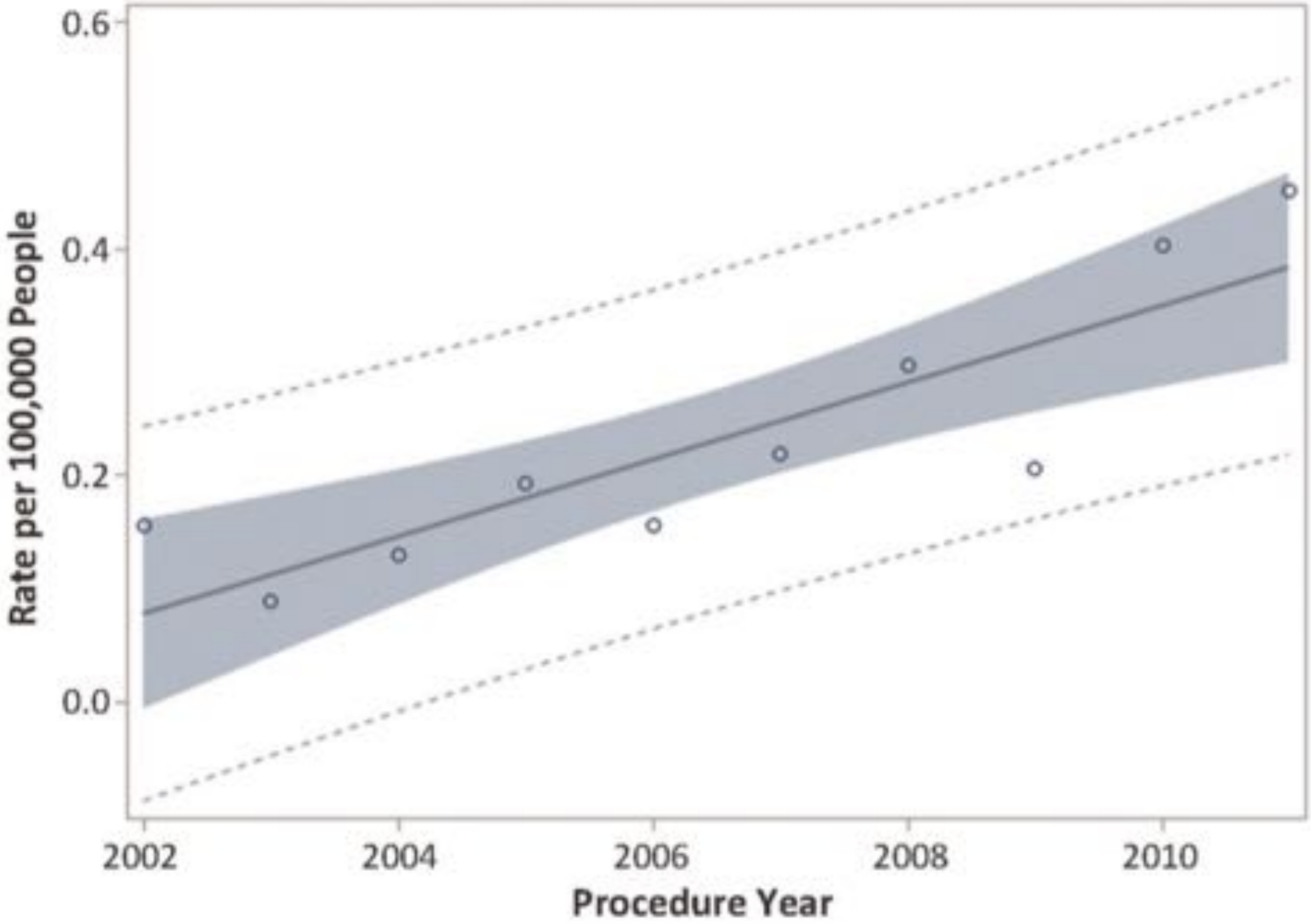
TABLE 2
Prevalence of Ulnar Collateral Ligament Reconstruction Among Pitchers

	Prevalence, % (n)	*P*
Current level		<.001
Major league	25 (96 of 382)	
Minor league	15 (341 of 2324)	

Conte SA, Fleisig GS, Dines JS, et al. Prevalence of Ulnar Collateral Ligament Surgery in Professional Baseball Players. *Am J Sports Med*. April 2015.



Hodgins JL, Vitale M, Arons RR, Ahmad CS. Epidemiology of Medial Ulnar Collateral Ligament Reconstruction: A 10-Year Study of New York State. *Am J Sports Med*. January 2016.



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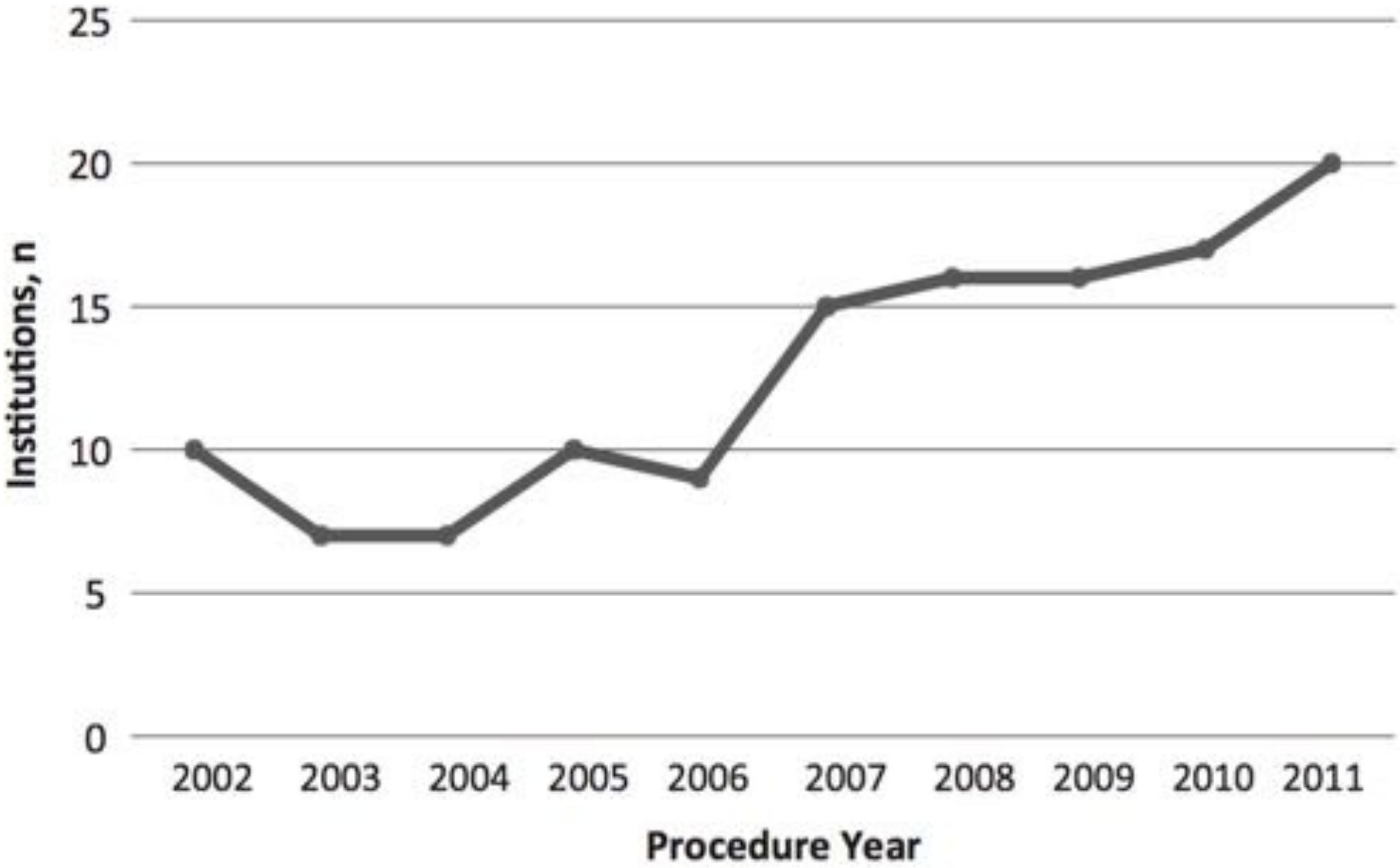

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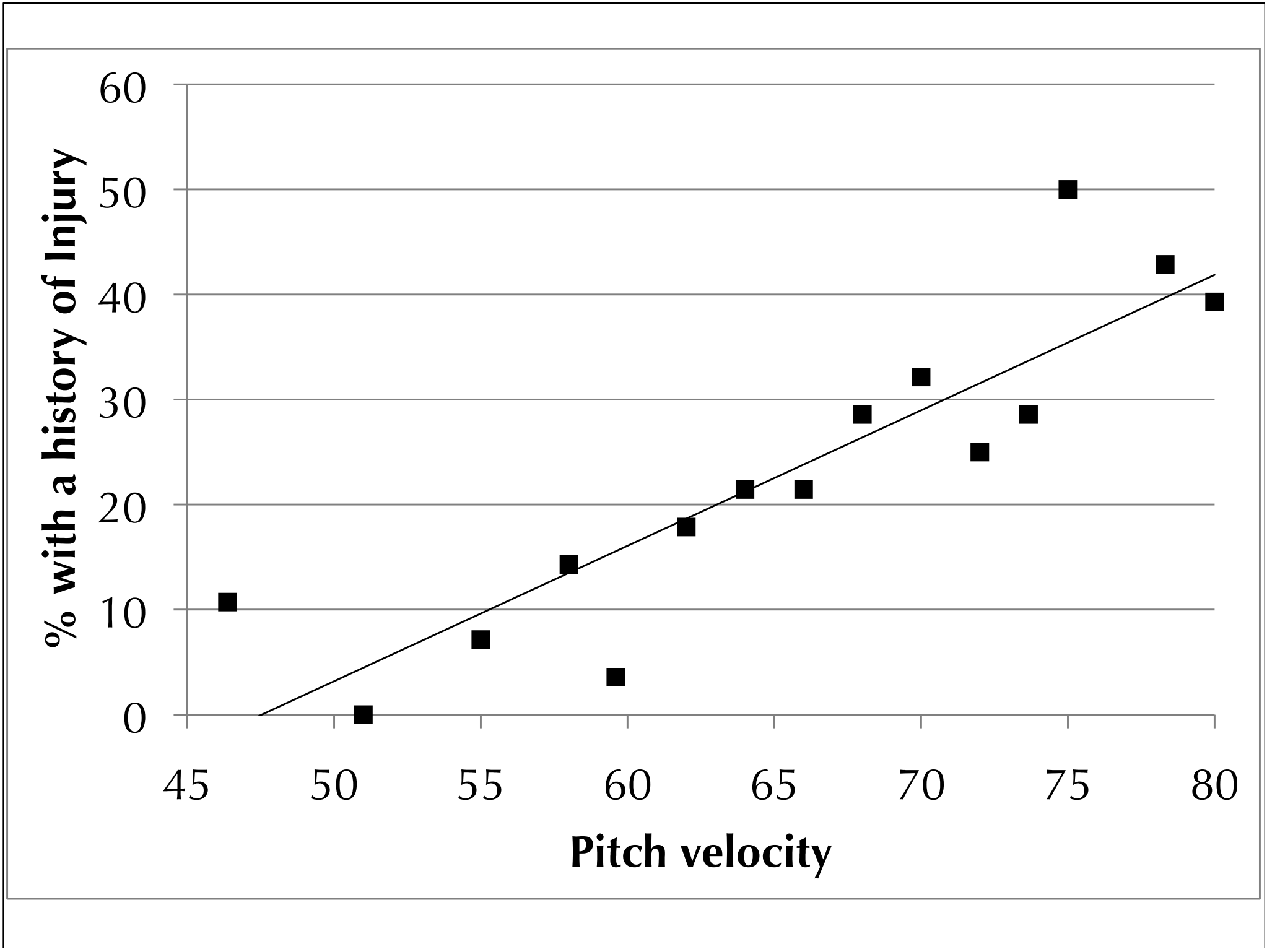
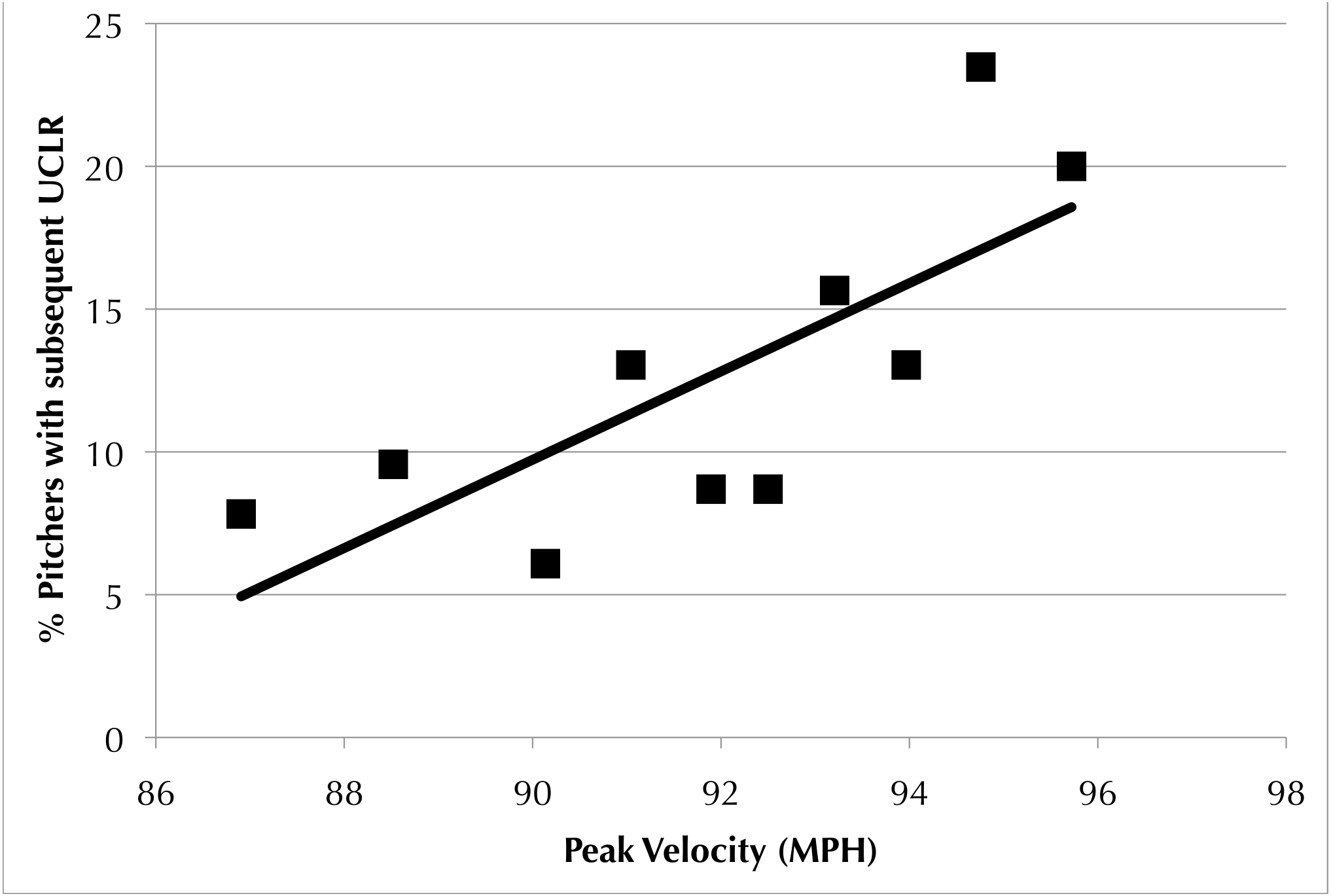
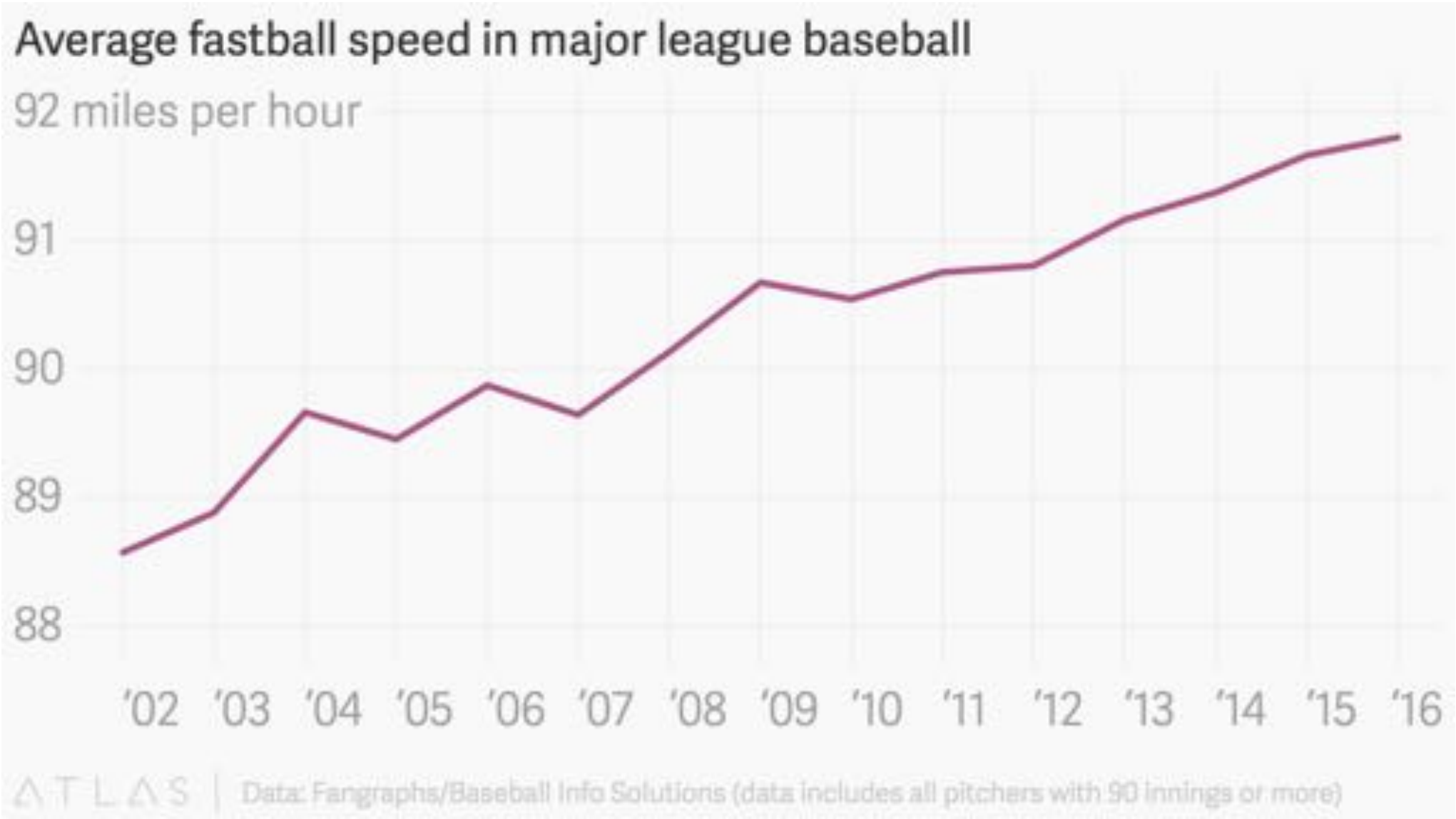
Causes


60
50
40
30
20
10
0
% with a history of Injury
45
50
55
60
65
70
75
80
Pitch velocity

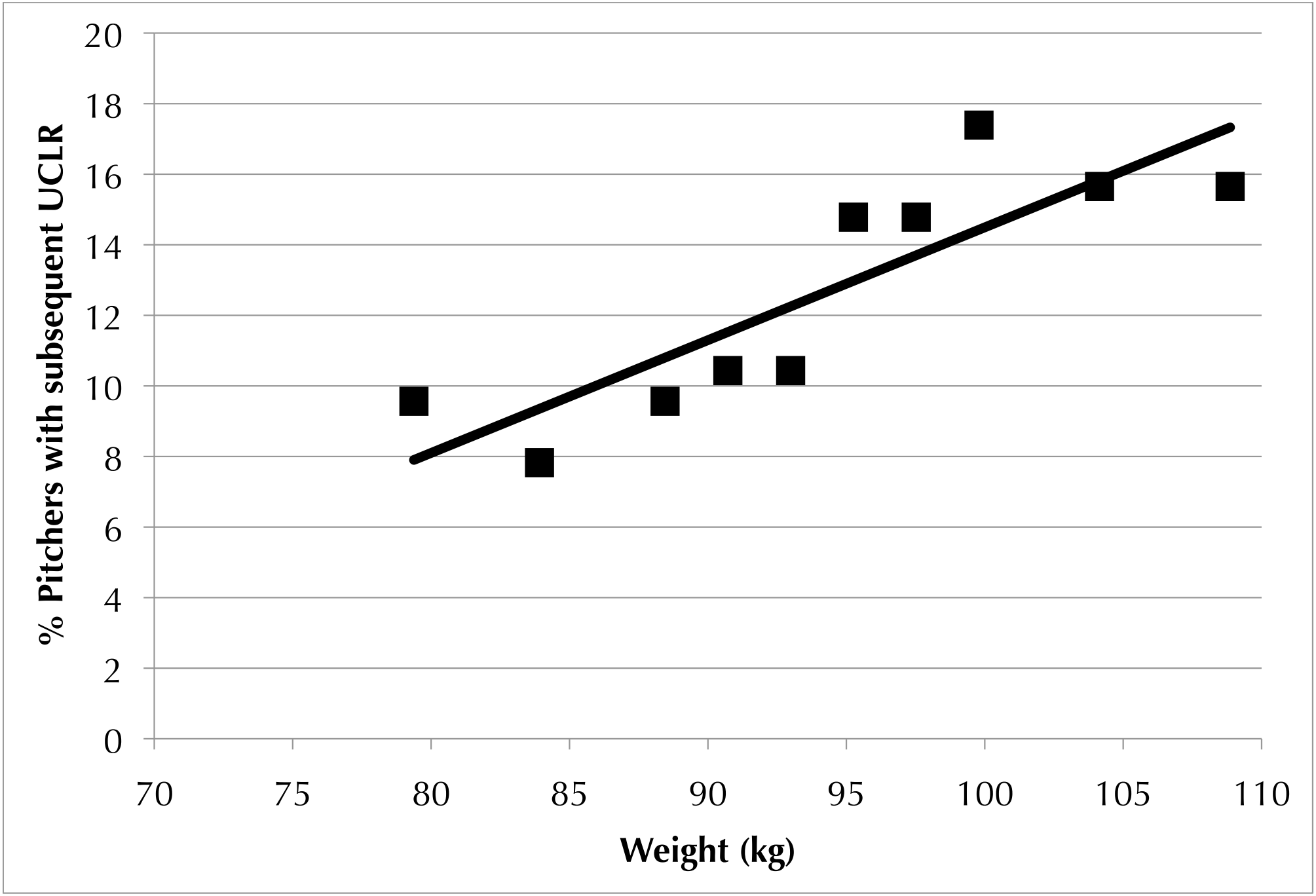

25
20
15
10
5
0
% Pitchers with subsequent UCLR
86
88
90
92
94
96
98
Peak Velocity (MPH)

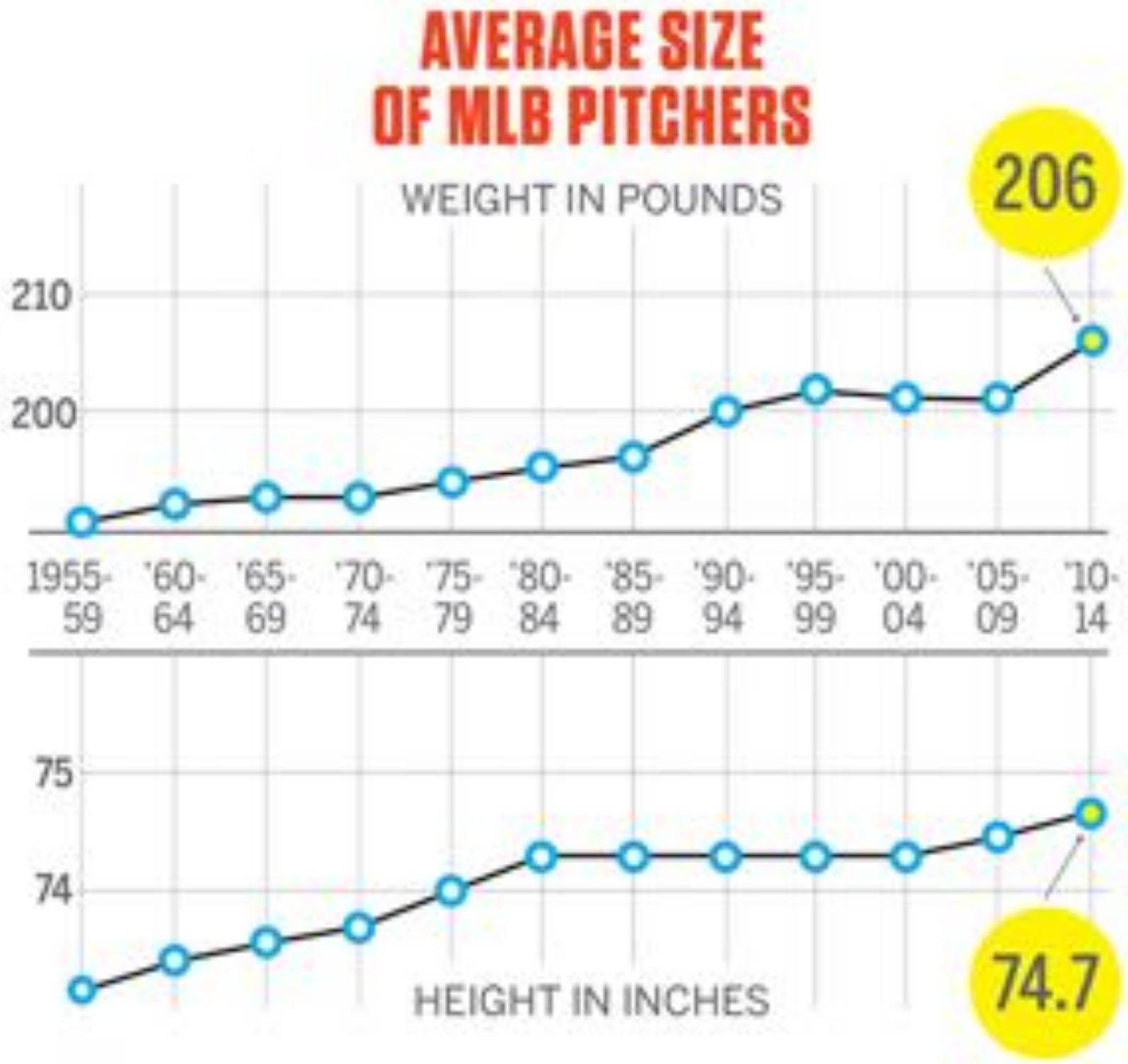


Fangraphs.com

PITCHERS WHO HIT 100 MPH 20 TIMES

SOURCE: BASEBALL INFO SOLUTIONS


20
18
16
14
12
10
8
6
4
2
0
% Pitchers with subsequent UCLR
70
75
80
85
90
95
100
105
110
Weight (kg)


AVERAGE SIZE
OF MLB PITCHERS
WEIGHT IN POUNDS
206
210
200
1955-59
'60-64
'65-69
'70-74
'75-79
'80-84
'85-89
'90-94
'95-99
'00-04
'05-09
'10-14
75
74
74.7
HEIGHT IN INCHES

Espn.con

Game pitch counts	No. of appearances	Elbow		Shoulder	
		Odds ratio	*P* value	Odds ratio	*P* value
Overall					
1–24	1023	Referent	0.07	Referent	<0.01
25–49	1060	1.03		1.15	
50–74	992	1.21		1.23	
75–99	476	1.35		1.52	
100+	238	1.44		1.77	
9 to 10 years old					
1–24	430	Referent	0.67	Referent	0.01
25–49	373	1.20		0.97	
50–74	346	1.40		1.11	
75–99	149	0.91		1.32	
100+	90	1.33		2.01	
11 to 12 years old					
1–24	319	Referent	0.60	Referent	0.94
25–49	353	0.84		0.98	
50–74	319	0.83		1.10	
75–99	164	1.30		1.14	
100+	70	0.87		0.76	
13 to 14 years old					
1–24	274	Referent	0.06	Referent	0.02
25–49	334	1.12		1.51	
50–74	327	1.38		1.65	
75–99	163	1.59		2.17	
100+	78	2.22		2.15	

Season pitches to date	No. of such appearances	Elbow		Shoulder	
		Odds ratio	*P* value	Odds ratio	*P* value
1–200	2126	Referent	<0.01	Referent	<0.01
201–400	957	1.63		1.65	
401–600	460	2.81		2.34	
601–800	194	3.34		2.90	
800+	52	2.61		3.29	

Lyman, S., Fleisig, G. S., Andrews, J. R., & Osinski, E. D. (2002). Effect of pitch type, pitch count, and pitching mechanics on risk of elbow and shoulder pain in youth baseball pitchers. *American Journal of Sports Medicine*, *30*(4), 463–468.

Counts: Further evidence

Risk Factor	Pitchers With an Injury, % (n)		Odds Ratio (95% Confidence Interval)	P^a
	With Risk Factor	Without Risk Factor		
Pitched at least 4 years in study	6 (10 of 154)	4 (14 of 327)	1.6 (0.69 to 3.51)	.37
Pitched more than 100 innings in 1 year	14 (4 of 29)	4 (20 of 452)	3.5 (1.16 to 10.44)	.049
Threw curveballs before 13 years old	7 (7 of 103)	4 (8 of 187)	1.6 (0.60 to 4.47)	.41
Played catcher at least 3 years in study	11 (4 of 35)	4 (20 of 446)	2.7 (0.93 to 8.19)	.088

TABLE 4
Odds Ratios of Arm Tiredness and/or Arm Pain by Risk-Prone Pitching Activity and Type of Pitching (N = 754)[a]

	Arm Tiredness When Pitching		Arm Pain When Pitching		Pitching-Related Injury	
	OR[b]	95% CI	OR[b]	95% CI	OR[b]	95% CI
Pitching competitive baseball for >8 months a year[c]						
Yes vs no	0.74	0.35-1.55	1.68	0.82-3.44	0.76	0.34-1.71
Pitching in leagues without pitch counts or limits						
Yes vs no	0.93	0.69-1.32	0.99	0.71-1.39	0.76	0.53-1.09
Pitching back-to-back days[c]						
Yes vs no	**4.36**	**1.87-10.15**	**2.53**	**1.14-5.60**	1.95	0.84-4.49
Pitching multiple games a day[c]						
Yes vs no	1.87	0.98-3.55	**1.89**	**1.03-3.49**	0.96	0.49-1.87
Pitching for multiple teams within the same season[c]						
Yes vs no	**3.37**	**1.76-6.30**	**1.85**	**1.02-3.38**	0.83	0.43-1.60

Yang, J., Mann, B. J., Guettler, J. H., Dugas, J. R., Irrgang, J. J., Fleisig, G. S., & Albright, J. P. (2014). Risk-Prone Pitching Activities and Injuries in Youth Baseball: Findings From a National Sample. *The American Journal of Sports Medicine*, *42*(6), 1456–1463.

Fleisig, G. S., Andrews, J. R., Cutter, G. R., Weber, A., Loftice, J., McMichael, C., et al. (2011). Risk of serious injury for young baseball pitchers: a 10-year prospective study. *The American Journal of Sports Medicine*, *39*(2), 253–257.

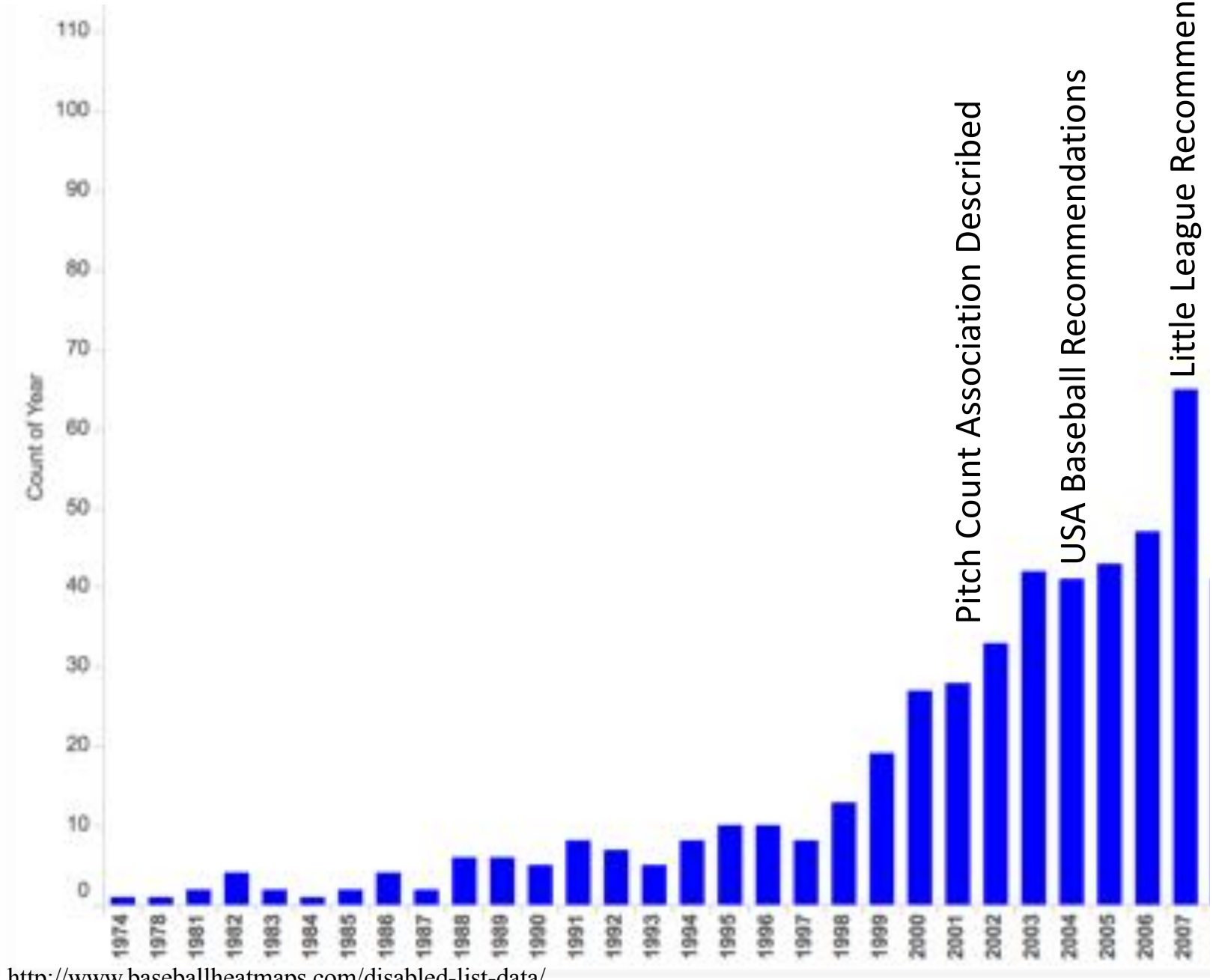
How much of a difference in pitch counts leads to injury?

Variable	History of injury	No history of injury	P
Pitches/Game	64±21	54±22	<0.001
Pitches/Year	1978±1679	1408±1491	0.001

10 pitches per game
500 pitches per year

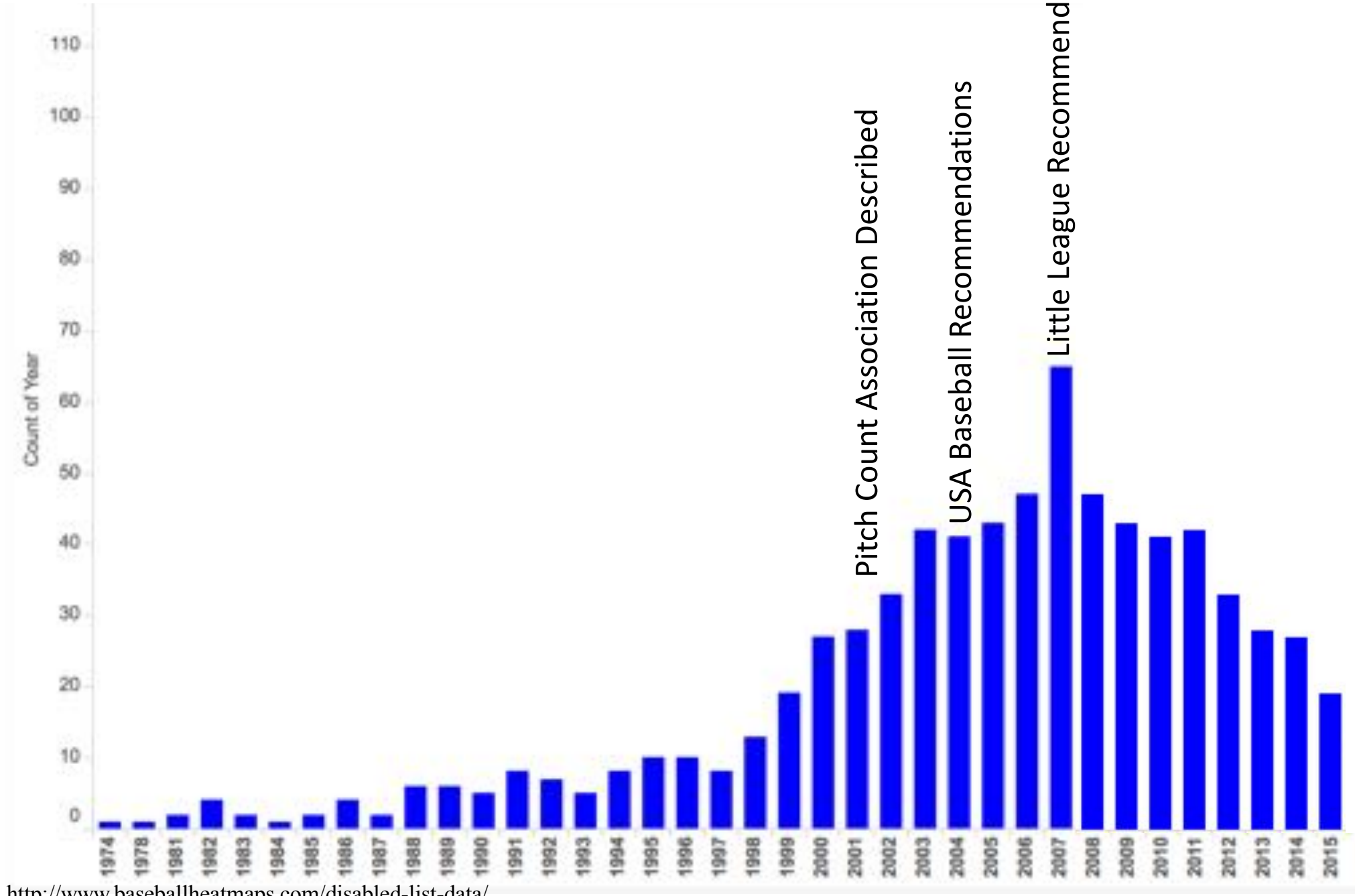
Chalmers, P. N., Sgroi, T., Riff, A. J., Lesniak, M., Sayegh, E. T., Verma, N. N., et al. (2015). Correlates With History of Injury in Youth and Adolescent Pitchers. *Arthroscopy*

Pitch Counts?



http://www.baseballheatmaps.com/disabled-list-data/

Expected



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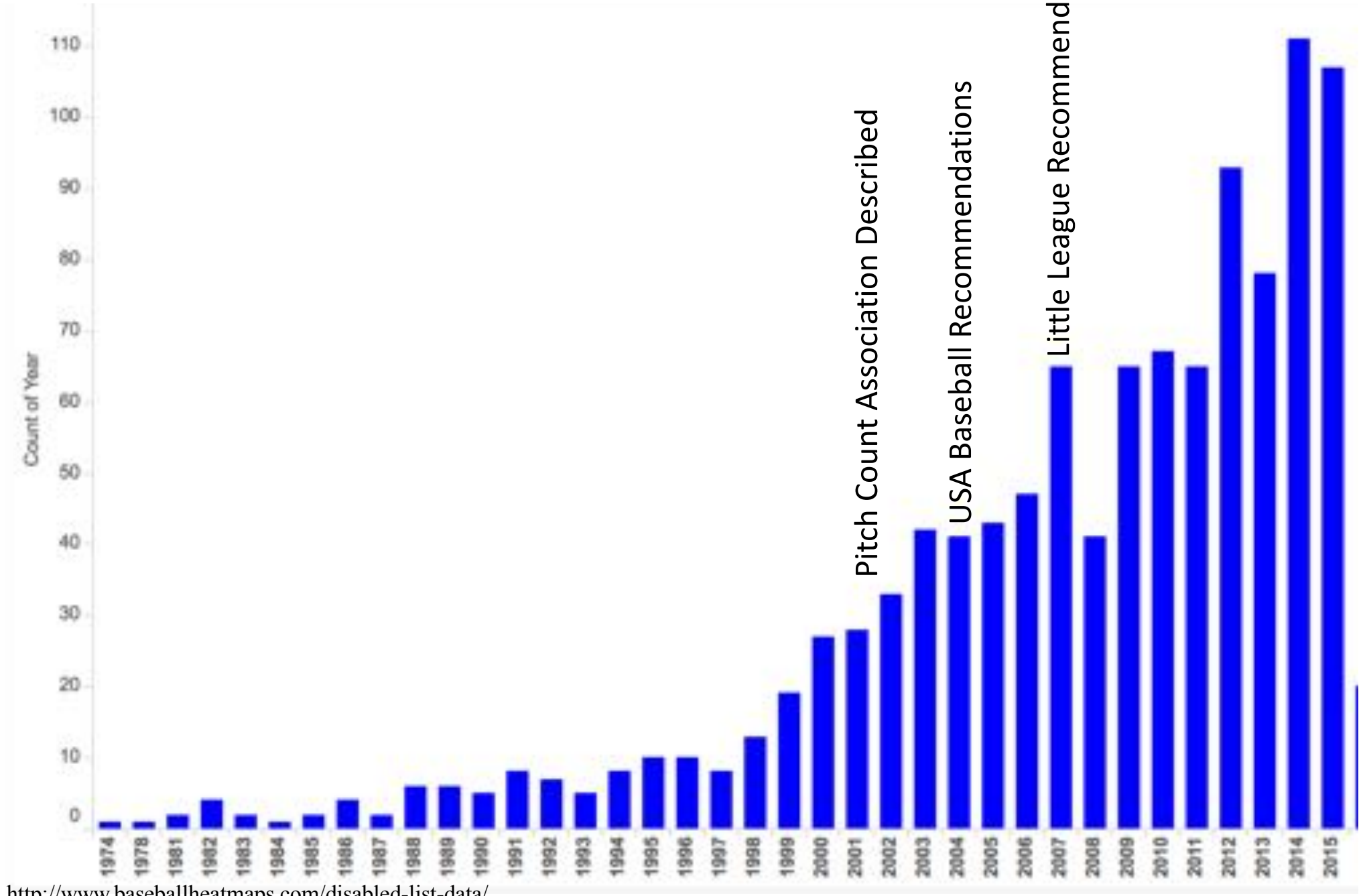
Observed



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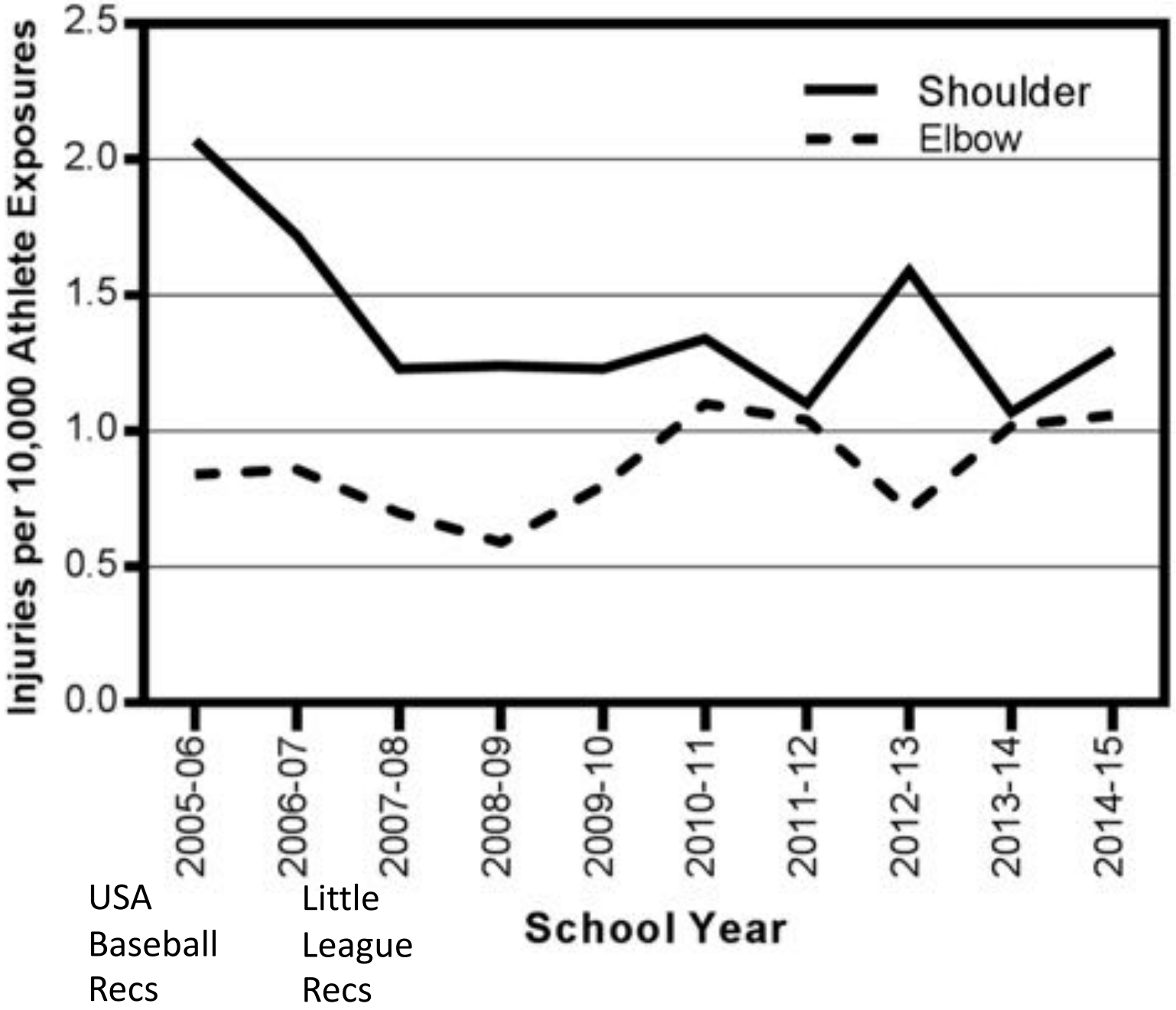

Saper MG, Pierpoint LA, Liu W, Comstock RD, Polousky JD, Andrews JR. Epidemiology of Shoulder and Elbow Injuries Among United States High School Baseball Players: School Years 2005-2006 Through 2014-2015. *Am J Sports Med*. October 2017:363546517734172.

Conclusions

- UCLR incidence has dramatically increased in
  - The MLB
  - Youth and Adolescent Pitchers
- Increased velocity, height, and weight may contribute
- Pitch Counts +/-empirically correlate
- Prevention:
  - Focus on mechanics, not velocity
  - Focus on at risk groups: heavy, tall, hard throwers
    - Core strengthening?
    - Flexor-Pronator strengthening?
    - Reduced Pitch Counts?


Thank you!