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TABLE E-1 Studies in which the 212 Published Cases of Glenohumeral Chondrolysis Were Reported*

First Author	Level of Evidence	Journal	Year	Cases	Patient Demographics		
					Mean Age *(yr)*	Male *(no.)*	Female *(no.)*
Kahan[85]	IV	J Rheum	1983	1	64		1
Tamai[86]	IV	Acta Orthop Scand	1997	2	43		2
Nakagawa[87]	IV	Bull Hosp Jt Dis	1998	1	35		1
Shibata[88]	IV	Int Orthop	2001	2	38	1	1
Petty (a)[22]	IV	Am J Sports Med	2004	2	17	1	1
Petty (b)[22]	IV	Am J Sports Med	2004	1	18		1
Valverde[89]	IV	J Bone Joint Surg Br	2004	1	51	1	
Levine[90]	IV	J Bone Joint Surg Am	2005	2	20	2	
Ciccone[91]	IV	Orthopedics	2007	1	26		1
Good[92]	IV	Arthroscopy	2007	8	23	2	6
Hansen[17]	III†	Am J Sports Med	2007	12	29		
Jerosch[93]	IV	Knee Surg Sports Traumatol Arthrosc	2007	1	48	1	
McCarty[20]	IV	J Shoulder Elbow Surg	2007	1	16		1
Sanders[25]	IV	AJR Am J Roentgenol	2007	4	21	3	1
Greis[84]	IV	J Bone Joint Surg Am	2008	4	16		4
Levy[19]	IV	J Shoulder Elbow Surg	2008	11	39		
Bailie (a)[16]	IV	J Shoulder Elbow Surg	2009	19	30	11	7
Bailie (b)[16]	IV	J Shoulder Elbow Surg	2009	4	32	2	2
Coobs[94]	IV	Am J Orthop	2009	2		1	1
McNickle (a)[21]	IV	Am J Sports Med	2009	15	19	12	3
McNickle (b)[21]	IV	Am J Sports Med	2009	1	16	0	1
McNickle (c)[21]	IV	Am J Sports Med	2009	4	16	2	2
Rapley[23]	III	Arthroscopy	2009	3			
Saltzman[24]	IV	Orthopedics	2009	1	37		1
Anakwenze[14]	IV	Clin Orthop Relat Res	2010	2	23		2
Anderson (a)[15]	IV	Arthroscopy	2010	16	24	14	2
Anderson (b)[15]	IV	Arthroscopy	2010	3	23	2	1
Hasan (a)[18]	IV	Arthroscopy	2011	33	27		
Hasan (b)[18]	IV	Arthroscopy	2011	3	33		
Hasan (c)[18]‡	IV	Arthroscopy	2011	2	55		2
Hasan (d)[18]‡	IV	Arthroscopy	2011	2	55		2
Wiater (a)[28]	II	J Bone Joint Surg Am	2011	11	43	7	4
Wiater (b)[28]	II	J Bone Joint Surg Am	2011	35	40	16	19
Wiater (c)[28]	II	J Bone Joint Surg Am	2011	3	42	3	0
Total of known data				213	Mean, 30	81	69

*When an article provides data on more than one clinical set of circumstances, the subsets are presented separately using letters such as (a) and (b). †Authors gave level of evidence as IV, but this is actually a Level-III prognostic study. ‡Includes data from Serrato et al.[27].

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TABLE E-2 Treatments Used in the 212 Published Cases of Glenohumeral Chondrolysis*

	Treatment							Anesthetic Infusion			
First Author	P+T+A	P+T	P+A	T+A	P	T	A	Agent	Concentration	Flow *(mL/hr)*	Duration *(hr)*
Kahan[85]											
Tamai[86]†											
Nakagawa[87]†											
Shibata[88]†											
Petty (a)[22]						2					
Petty (b)[22]					1			Bupivacaine	0.50%		
Valverde[89]‡											
Levine[90]						2					
Ciccone[91]						1					
Good[92]				2		6					
Hansen[17]	3	1	6		2			Bupivacaine	0.25%	4	48
Jerosch[93]						1					
McCarty[20]						1					
Sanders[25]				4							
Greis[84]					4			Bupivacaine	0.50%	4	48
Levy[19]	7			1	2	1					
Bailie (a)[16]	4	1	10		1	2	1	Bupivacaine	0.25%	5	48
Bailie (b)[16]§											
Coobs[94]				1		1					
McNickle (a)[21]	1	1	7		6			Bupivacaine	0.50%		72
McNickle (b)[21]		1						Bupivacaine	0.25%		72
McNickle (c)[21]						2	2				
Rapley[23]			2		1			Bupivacaine	0.50%	4	65
Saltzman[24]			1					Lidocaine	2%	2	
Anakwenze[14]			1		1			Bupivacaine			
Anderson (a)[15]			16					Bupivacaine	0.50%	5	55
Anderson (b)[15]			3					Bupivacaine	0.50%	2	55
Hasan (a)[18]		3	30					Bupivacaine			
Hasan (b)[18]							3				
Hasan (c)[18]#					2			Bupivacaine	0.50%	2	55
Hasan (d)[18]#					2			Bupivacaine	0.25%	2	55
Wiater (a)[28]	3		6		2			Bupivacaine	0.50%	5	48
Wiater (b)[28]			18		17			Lidocaine	2.00%	5	48
Wiater (c)[28]			1		2						
Total	18	7	101	8	43	19	6				

*When an article provides data on more than one clinical set of circumstances, the subsets are presented separately using letters such as (a) and (b). P = pain pump, T = thermal (radiofrequency or laser), and A = suture anchor. †Glenohumeral joint injected with dye. ‡Glenohumeral joint injected with chlorhexidine. §Received a 20-cc intra-articular bolus injection of 0.25% bupivacaine with epinephrine. #Includes data from Serrato et al.[27].

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TABLE E-3 Summary of Data from Laboratory Studies on the Effects of Local Anesthetics on Chondrocytes and Cartilage*

First Author	Year	Model	Duration or Volume	Agent	Result
Nole (a)[11]	1985	Porcine and canine cartilage	2 hr	0.06% to 0.5% bupivacaine + saline solution	Dose-related suppression of sulfate uptake at 24 hr, toxic effect of saline solution
Nole (b)[11]	1985	Porcine and canine knee joints in vivo	12-mL injection	0.25%, 0.5% bupivacaine + saline solution	No ultrastructural changes at 4 d
Jaureguito[95]	2002	Human cartilage	2 hr	Morphine + saline solution; 0.25% bupivacaine	No impairment of sulfate uptake, no histological damage at 3 d
Dogan[34]	2004	Lapine knee joints in vivo	0.25-mL injection	0.5% bupivacaine	Cartilage and synovial inflammation at 10 d
Chu (a)[5]	2006	Bovine chondrocytes		0.5% bupivacaine	>99% chondrocyte death/ apoptosis at 1 hr, 1 wk
Chu (b)[5]	2006	Bovine cartilage	30 min	0.5% bupivacaine	Chondrocyte death at 24 hr, % increased when cartilage surface layer removed
Gomoll[38]	2006	Lapine shoulder joints in vivo	48 hr	0.25% bupivacaine	Chondrocyte toxicity and decreased sulfate uptake at 5 d
Karpie (a)[42]	2007	Bovine chondrocytes	15, 30, 60 min	1%, 2% lidocaine	Dose and time dependent cytotoxicity at 1 hr to 1 wk
Karpie (b)[42]	2007	Bovine cartilage	30 min	1%, 2% lidocaine	Death in surface chondrocytes at 24 hr; intact surface not protective against lidocaine
Chu (a)[4]	2008	Bovine and human chondrocytes	15, 30, 60 min	0.125%, 0.25%, 0.5% bupivacaine	Time and dose-dependent reduction in viability at 1 hr to 1 wk
Chu (b)[4]	2008	Bovine cartilage	30 min	0.125%, 0.25%, 0.5% bupivacaine	Surface layer chondrocyte death at 24 hr greater when cartilage surface removed
Dragoo[35]	2008	Human chondrocytes	24, 48, 72 hr	0.25%, 0.5% bupivacaine; 1% lidocaine	Dose and time-dependent cytotoxicity for bupivacaine, 1% lidocaine not toxic
Piper (a)[13]	2008	Human chondrocytes	30 min	0.5% ropivacaine; 0.5% bupivacaine	Bupivacaine more toxic than ropivacaine at 24 hr
Piper (b)[13]	2008	Human cartilage	30 min	0.5% ropivacaine; 0.5% bupivacaine	Bupivacaine toxic at 24 hr, intact surface protective against ropivacaine
Seshadri[43]	2009	Bovine chondrocytes	15, 30 , 60 min	1% lidocaine + methylprednisolone	Toxic, necrosis and apoptosis at 1 to 7 d
Gomoll[39]	2009	Lapine shoulder in vivo	48 hr	0.25% bupivacaine	No lasting impairment of sulfate uptake at 3 mo
Anz[29]	2009	Canine synovium and cartilage	48 hr	0.5% bupivacaine	100% loss of chondrocyte viability
Lo[8]	2009	Bovine cartilage	1, 3, 5, 8, 12 hr	0.25% bupivacaine; 1% lidocaine; 0.5% ropivacaine	Time and dose-dependent effect on chondrocyte membrane integrity and nuclear morphology

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TABLE E-3 (*continued*)

First Author	Year	Model	Duration or Volume	Agent	Result
Bogatch[31]	2010	Bovine chondrocytes	1 hr	0.25%, 0.5% bupivacaine; 1% lidocaine	96% cell death when mixed with human synovial fluid
Chu[33]	2010	Murine knees in vivo	100-mL injection	0.5% bupivacaine	Reduced chondrocyte density without cartilage tissue loss at 6 mo
Dragoo[36]	2010	Human chondrocytes	24 hr	0.25% bupivacaine; 1% lidocaine	No significant toxicity (<20%) unless ph < 5 or if preservatives present
Farkas (a)[37]	2010	Human chondrocytes	2, 6, 24 hr	0.5% bupivacaine; 1% lidocaine; 0.75% ropivacaine	Bupivacaine most toxic, steroids not protective at 24 hr, steroids accentuate toxicity
Farkas (b)[37]	2010	Human cartilage	24 hr	1% lidocaine	Steroid + lidocaine more toxic to superficial zone than lidocaine alone
Hennig[7]	2010	Canine cartilage	5, 15, 30 min	0.5% bupivacaine	Superficial zone toxicity, worse with preservative methylparaben, pH as low as 5 not toxic
Grishko[40]	2010	Human chondrocytes	1 hr	0.5%, 1%, 2% lidocaine; 0.25%, 0.5% bupivacaine; 0.2, 0.5% ropivacaine	Dose-effect toxicity at 5 d due to mitochondrial DNA damage and reduced ATP production
Syed (a)[44]	2011	Human chondrocytes	15 min	0.25% bupivacaine	Toxic, worse if with triamcinolone or if buffered
Syed (b)[44]	2011	Human cartilage	15 min	0.25% bupivacaine	Toxic if buffered, superficial layer protective if intact
Baker[30] (Arthroscopy)	2011	Human chondrocytes	15 min	2% lidocaine; 0.5% levobupivacaine; 0.5% bupivacaine; 0.75% ropivacaine	Toxic to chondrocytes, magnesium may reduce toxicity
Baker[79] (Knee Surg Sports Traumatol Arthrosc)	2011	Human chondrocytes	15 min	0.13%, 0.25%, 0.5% bupivacaine; 0.19%, 0.38%, 0.75% ropivacaine; 0.25%, 0.5% levobupivacaine	Dose-related toxic effects
Jacobs[41]	2011	Human chondrocytes	15, 30 , 60 min	1%, 2% lidocaine	Dose and time-dependent toxicity at 1 wk
Miyazaki[10]	2011	Bovine chondrocytes	1, 12, 24 hr	0.125%, 0 .25%, 0 .5%, 1% lidocaine	Dose and time-dependent toxicity
Park[12]	2011	Equine chondrocytes	30, 60 min	0.125%, 0.25%, 0.5% bupivacaine; 0.5%, 1%, 2% lidocaine; 0.5%, 1%, 2% mepivacaine	Dose and time-dependent toxicity
Braun[32]	2012	Human chondrocytes	Injection	1% lidocaine; 0.25% bupivacaine	At 14 d, minimal effect when used alone, significant toxicity when used with steroids
Dragoo (a)[6]	2012	Human chondrocytes	6, 12 hr	0.25% bupivacaine; 0.5% ropivacaine	No significant toxicity at 1 wk
Dragoo (b)[6]	2012	Human cartilage	3 hr	1% lidocaine	Toxic at 2 wk

*When an article provided data on two different model systems, the subsets are presented separately using letters such as (a) and (b).