

TABLE E-1 Immunohistochemistry Results*

Result No.	Elbow Capsule	Time After Trauma	Qualitative	Quantitative	
			Capsule	Myofibroblasts	α-SMA†
Controls					
1	Autopsy	NA	Normal capsule	No	0
2	Autopsy	NA	Normal capsule	No	0
3	Autopsy	NA	Normal capsule	No	0
4	Autopsy	NA	Normal capsule	No	0
5	Autopsy	NA	Normal capsule	No	0
Acute trauma less than seven days					
1	Simple olecranon fracture (operatively treated within hours)	0 days	Posttraumatic acute	No	0
2	Simple olecranon fracture (operatively treated within hours)	0 days	Posttraumatic acute	No	0
3	Radial head fracture-dislocation (operatively treated within hours)	0 days	Posttraumatic acute	No	0
4	Olecranon fracture-compound (operatively treated within fourteen hours)	0.5 day	Posttraumatic acute	No	0
5	Capitellum fracture	1 day	Posttraumatic acute	Yes	1
6	Coronoid fracture-dislocation with associated lateral collateral ligament or medial collateral ligament injury	3 days	Posttraumatic acute	No	0
7	Monteggia radial head fracture-dislocation	3 days	Posttraumatic acute	No	0
8	Transolecranon fracture-dislocation	3.5 days	Posttraumatic acute	No	0
9	Posterior olecranon fracture-dislocation with associated coronoid and radial head fractures	4 days	Posttraumatic acute	No	0
10	Radial head fracture	4 days	Posttraumatic acute	No	0
11	Capitellum and radial head fracture	4 days	Posttraumatic acute	No	0
Acute trauma seven days or more					
12	Coronal shear fracture of the distal humerus	7 days	Posttraumatic subacute	Yes	3
13	Posterior olecranon fracture-dislocation and fractures coronoid and radial head	7 days	Posttraumatic acute	Yes	3
14	Transolecranon fracture-dislocation with associated radial head fracture	8 days	Posttraumatic subacute	Yes	3
15	Radial head fracture	9 days	Posttraumatic acute	No	0
16	Coronoid anteromedial facet fracture	9 days	Posttraumatic acute	Yes	1
17	Distal humeral fracture	10 days	Posttraumatic acute	Yes	1
18	Transolecranon fracture-dislocation	14 days	Posttraumatic subacute	Yes	2
19	Distal humeral fracture	14 days	Posttraumatic subacute	Yes	3
20	Distal humeral fracture	14 days	Posttraumatic subacute	Yes	3
21	Revision Monteggia radial head fracture-dislocation (posterior capsule)	14 days	Posttraumatic subacute	No	0
Posttraumatic elbow contracture release more than five months					
1	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
2	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
3	Posttraumatic contracture	>5 months	Arthrofibrosis	Yes	2
continued					

continued

TABLE E-1 (continued)

Result No.	Elbow Capsule	Time After Trauma	Qualitative	Quantitative	
			Capsule	Myofibroblasts	α -SMA†
4	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
5	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
6	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
7	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
8	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
9	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
10	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
11	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
12	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
13	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
14	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
15	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
16	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
17	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
18	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
19	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
20	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
21	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
22	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
23	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
24	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
25	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
26	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
27	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
28	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
29	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
30	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
31	Posttraumatic contracture	>5 months	Arthrofibrosis	Yes	1
32	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
33	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
34	Posttraumatic contracture	>5 months	Arthrofibrosis	No	0
Control with olecranon fracture					
1	Autopsy-acute olecranon fracture (unknown number of days)	Unknown time	Posttraumatic subacute	Yes	2
Operative elbow contracture release: nontraumatic examples					
1	Diagnosis of rheumatoid arthritis: history of pain and poor motion	NA		Yes	2
2	Diagnosis of degenerative change without history of fractures	NA		Yes	1

*NA = Not available. †A semiquantitative scoring system was used for α -SMA staining as follows: 0 for no staining (except from staining in blood vessel walls), 1 for weak focal staining, 2 for weak diffuse staining, and 3 for moderate diffuse or focal strong staining of fibroblast-like stromal cells (Fig. 1).

TABLE E-2 Study Details on Myofibroblasts for Human Elbow Capsules

Human Elbow Capsule No.	Reference	Time Point	Conclusion
1	Hildebrand ³⁴	14 ± 9 (5 to 25)§	Myofibroblast numbers are elevated in human elbow capsules in chronic stages (>5 mo) after trauma
2	Hildebrand ¹¹	15 ± 7 (5 to 25)§	High rate of joint capsule matrix turnover in chronic (>5 mo) human elbow contractures
3	Germscheid and Hildebrand ³⁵	Not reported	Elevated myofibroblast numbers occur throughout the whole joint capsule in elbow contractures
4	Hildebrand ³⁶	15 ± 7 (5 to 25)§	Myofibroblast upregulators are elevated in joint capsules in chronic stages of posttraumatic contractures
5	Cohen ¹⁰	Long-standing elbow contractures	Pathologic thickening, disorganization of collagen fiber arrangement and involvement of cytokines in (chronic) posttraumatic contracture
6	Current study	Acute trauma (<14 d) and elbow contractures (>5 mo)	Myofibroblast cells are expressed early posttrauma, not in chronic stages

*The values are given as the mean and standard deviation. †Images (200×) were captured under a Zeiss light microscope (Axioskop 2 plus; Carl Zeiss Canada, Toronto, Ontario, Canada) with Image-Pro Plus (Media Cybernetics, Silver Spring, Maryland). ‡The values are given as the mean and the standard deviation of the percentage of the total number of cells. §The values are given as the mean and the standard deviation of months after trauma, with the range in parentheses. #The values were significant at $p < 0.001$. **The values were significant at $p < 0.05$.

TABLE E-2 (continued)

No. Patients	Total No. of Cells per Field*†	No. of Myofibroblasts (α-SMA)†‡	Percentage of Myofibroblasts†‡	Technique
6	Control (organ donor): 919 ± 187	69 ± 41	9 ± 4	Immunolocalization analysis
6	Posttraumatic contractures: 845 ± 335	326 ± 61	36 ± 4#	
11	Not evaluated	Not evaluated	Not evaluated	Analysis of joint capsule matrix molecule mRNA levels
6	Controls (organ donors): 194 ± 31	19 ± 3	10 ± 1	Immunolocalization analysis
8	Posttraumatic contractures: 234 ± 51	46 ± 12	20 ± 5**	
11	Not evaluated	Not evaluated	Not evaluated	mRNA analysis of upregulators myofibroblasts
37	Not evaluated	Not evaluated	Not evaluated	Structural and biochemical evaluation
61	Not evaluated	Not evaluated	Not evaluated	Qualitative and quantitative immunohistochemistry analysis

TABLE E-3 Study Details on Myofibroblasts for Rabbit Knee Capsules

Rabbit Knee Capsule No.	Reference	Time Point	Conclusions
1	Hildebrand ³⁹	8 wk postop. (0 wk remobilization)† 32 wk postop. (24 wk of remobilization)	Myofibroblast numbers are elevated four to five times in rabbit knee model of posttraumatic (chronic) joint contractures
2	Hildebrand ¹²	8 to 32 wk postop.	Joint matrix turnover in rabbit model is similar to those observed in human joint capsules from chronic elbow contractures
3	Hildebrand ⁴⁰	4 wk postop.**	Joint capsule changes in acute stages of posttraumatic contractures are similar to those in the chronic stages in the rabbit model
4	Monument (Hildebrand group)	8 wk postop. 8 wk postop.	Myofibroblast numbers in the operative (chronic) contracture group were significantly increased compared with values in controls
5	Abdel ³⁷ (Morrey group)	2 wk postop. 8 wk postop. 8 wk postop. and 16 wk of remobilization	Myofibroblast cells are preferentially expressed early in a rabbit model of joint contracture and return to normal in chronic stages

*The values are given as the mean and standard deviation. †The values are given as the mean and the standard deviation of the percentage of the total number of cells. ‡The sixteen-week details are not included in this table. §Images (200×) were captured under a Zeiss light microscope (Axioskop 2 plus; Carl Zeiss Canada, Toronto, Ontario, Canada) with Image-Pro Plus (Media Cybernetics, Silver Spring, Maryland). #These values were significant at $p < 0.05$. **Two and six-week postoperative details were not mentioned in the text. ††Images were captured at 400× using the DXC-970MD digital camera (Sony, New York, NY) with IV-4XX imaging software (Sony). ‡‡The values were significant at $p < 0.001$. §§The values were significantly different from the control group at $p < 0.001$. ##The values were significantly different from the control group at $p = 0.04$. ***The values were significantly different from the control group at $p = 0.014$. †††These values were not significant.

TABLE E-3 (continued)

No. of Rabbits	Total No. of Cells Per Field*	No. of Myofibroblasts (α -SMA)*	Percentage of Myofibroblasts†	Technique
7	Nonoperative control: $285 \pm 43\text{\S}$	$33 \pm 2\text{\S}$	$12 \pm 1\text{\S}$	Not evaluated
	Operative contracture: $280 \pm 56\text{\S}$	$147 \pm 43\text{\S\#}$	$53 \pm 2\text{\S\#}$	
7	Nonoperative control: $336 \pm 20\text{\S}$	$33 \pm 6\text{\S}$	$11 \pm 1\text{\S}$	Not evaluated
	Operative contracture: $372 \pm 44\text{\S}$	$141 \pm 18\text{\S\#}$	$44 \pm 2\text{\S\#}$	
6	Not evaluated	Not evaluated	Not evaluated	
6	Nonoperative control: $294 \pm 47\text{\dagger\dagger}$	$28 \pm 5\text{\dagger\dagger}$	$9.0 \pm 1.0\text{\dagger\dagger}$	Immunohistochemical data
	Operative contracture: $308 \pm 40\text{\dagger\dagger}$	$135 \pm 20\text{\dagger\dagger}$	$47.0 \pm 2.0\text{\dagger\dagger\#\#}$ ($p < 0.001$)	
8	Nonoperative control: $244 \pm 35\text{\S}$	$30 \pm 7\text{\S}$	$12 \pm 1\text{\S}$	Immunohistochemical data
13	Operative contracture: $543 \pm 124\text{\S}$	$267 \pm 61\text{\S\S\S}$	$49 \pm 2\text{\S\S\S}$	
6	Nonoperative control: $83.8 \pm 4.9\text{\dagger\dagger}$	$5.7 \pm 5.9\text{\dagger\dagger}$	$6.8 \pm 6.4\text{\dagger\dagger}$	Immunohistochemical data
	Operative contracture: $113.6 \pm 7.5\text{\dagger\dagger}$	$22.6 \pm 7.8\text{\dagger\dagger\#\#}$	$19.9 \pm 3.1\text{\dagger\dagger***}$	
6	Nonoperative control: $78.2 \pm 24.4\text{\dagger\dagger}$	$2.8 \pm 3.4\text{\dagger\dagger}$	$3.0 \pm 2.6\text{\dagger\dagger}$	
	Operative contracture: $78.1 \pm 13.6\text{\dagger\dagger}$	$7.8 \pm 2.4\text{\dagger\dagger\dagger\dagger\dagger}$	$3.0 \pm 2.7\text{\dagger\dagger\dagger\dagger\dagger}$	
6	Nonoperative control: $80.3 \pm 14.4\text{\dagger\dagger}$	$0.4 \pm 0.35\text{\dagger\dagger}$	$0.6 \pm 0.5\text{\dagger\dagger}$	
	Operative contracture: $75.7 \pm 15.1\text{\dagger\dagger}$	$1.4 \pm 0.7\text{\dagger\dagger\dagger\dagger\dagger}$	$1.5 \pm 0.7\text{\dagger\dagger\dagger\dagger\dagger}$	