



Research Article

Correlation Between the Cartilage Angle of the Superior Part of the Femoral Trochlear Groove Measured in US and the Anterior Knee Pain

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Summary

Aim of the Study: The aim of the study was assesment of the correlation between the cartilage angle of the upper max. 5mm of the femoral groove assesed in US and the pain of the the anterior knee assesed clinically. Bony angle was assesed by the way to see what is the difference between both.

Materials and Methods: 162 patients were enrolled in the study. 78 (48%) men and 84 (52%) women. Mediana of the mans age was 35 years (IQR: 24 - 45), mediana for the womens age: 38 (IQR: 26 - 54).The cartilaginous and the bony angle of the upper part (max 5mm) of the femoral groove were measured by US and the data from interviews and physical examination were analyzed for the presence of typical patello-femoral pain symptoms.

From the obtained data it is stated that statistically important number of patients had less frequently pain of the Patello-Femoral Joint (PFJ) with the cartilage groove angle below 160°. Above that angle the number of painful knees increases with statistical importance and above 170° there is hihg propability of patellar luxation at some point of life.

Conclusions: The study indicates a high correlation between only one parameter of the Patello-Femoral Joint (PFJ) and anterior knee pain. It is both the strength and the weakness of it. If a single parameter gives statistically important angle treshold in 162 measurements that means it is a valuable tool for evaluation of the PFJ's future. On the other hand there are combinations of many factors, of which the most important is the patellar height [1].

Keywords: Femoral Groove; Patello-Femoral Joint; US

Introduction

The femoral groove and its dysplasia is currently evaluated based on Dejour's work on lateral x-ray of the knee [2]. The groove is not directly measured as an angle but as the depth of the groove at its mid-lower part. The norm is approx 130°. Author proposes criteria of correlation between the upper groove angle and anterior knee pain based on the angle of the femoral groove measured in US at its highest part (approx 5mm from the cartilage upper margin).

Aim of the study

The aim of the study was assesment of the correlation between the cartilage angle of the upper max. 5mm of the femoral groove

assesed in US and the pain of the the anterior knee assesed clinically. Bony angle was assesed by the way to see what is the difference between both.

Materials and Methods

There were 162 patients/knees in the study: 78 (48 %) men and 84 (52%) women. Mediana of the men age was 35years (IQR: 24 - 45), mediana of the women age: 38years (IQR: 26 - 54). A cartilaginous and the bony groove angle were measured by US and the analyzed by a clinical data from the interview and the examination.

Results

The results show that there are statistically much less knees with pain when the cartilage angle of the upper femoral groove is below

160°. Above this value the number of patients with pain statistically importantly rises and above 170° there is high possibility of patellar luxation (Tables 1-5, Figures 1,2).

There are two statistical options

1. Seek the cut-off angle values for pain
2. Seek the cut-off angle values for no pain

The first option seems more natural as we usually search for the disease not the lack of it. Upper groove angle as a predictor of pain. The study results show that the higher value of the groove angle the higher propability of pain.

For the angle 173° - sensitivity 16 %, specificity 100 %

For the angle 161° - sensitivity 37 %, specificity 90 %

For the angle 146° - sensitivity 87 %, specificity 30 %

For the angle 137,4° - sensitivity 100 %, specificity 5 %

	median (IQR)
Cartilage angle	152.8 (146.5 - 159,9)
Bone angle	144.9 (139.0 - 152,5)

Table 1: The groove angles in the whole group.

	men	women	p
	median (IQR)	median (IQR)	
Cartilage angle	153.9 (147.4 - 160.1)	151.7 (145.8 - 158.0)	0.248
Bone angle	144.4 (137.9 - 151.0)	145.0 (139.4 - 153.2)	0.546

Table 2: Median of the angles with the division into genders.

	pain, n=62	No pain, n=100	p
	median (IQR)	median (IQR)	
Cartilage angle	157.6 (150.5 - 167.2)	150. 5 (144,9 - 156.5)	< 0.001
Bone angle	149.4 (142.0 - 156.5)	142.9 (136.3 - 149.5)	< 0.001

Table 3: Median of the angles for the knees with and without pain of the anterior knee.

The values of both groove angles differ with a statistical importance in the group with and without pain.

Cartilage angle	No pain	pain	all (raw)
< 140°	11 (92 %)	1(2%)	12
140°-160°	76 (68 %)	36 (32 %)	112
>160°	13 (34 %)	25 (66 %)	38
all (column)	100	62	162

Table 4: The spread of pain/no pain in the three cartilage angle segments.

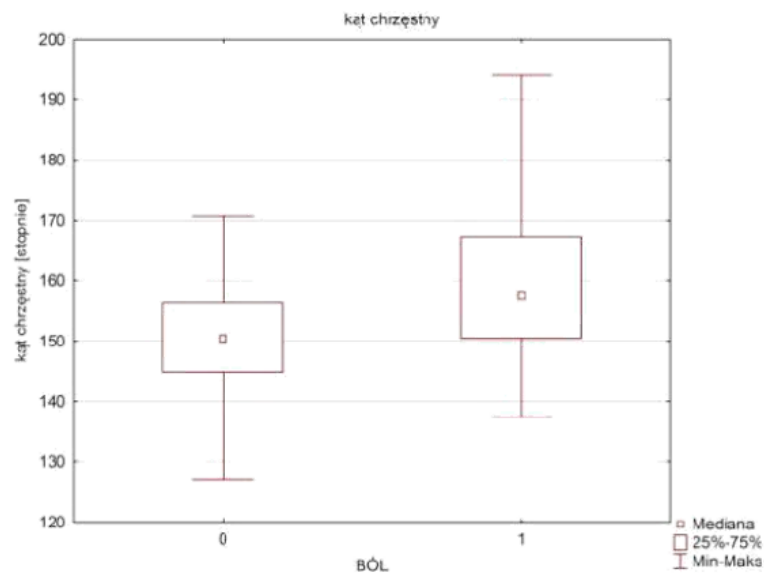


Figure 1: Median cartilage groove angle.

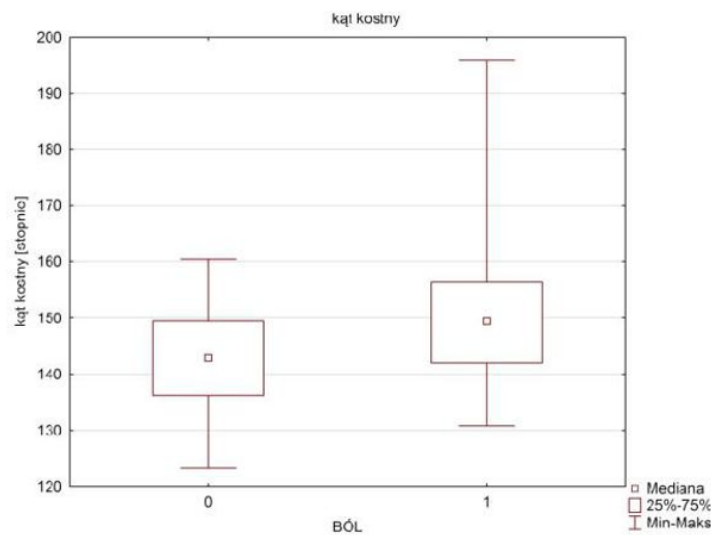


Figure 2: Median bony groove angle.

Angle	Pain	No pain	TRUE	TRUE	FALSE	TRUE	sensitivity	specificity
value			positive	negative	negative	negative		
194.1	1	0	1	0	61	100	0.016	1
190.3	1	0	2	0	60	100	0.032	1
186.5	1	0	3	0	59	100	0.048	1
178.8	1	0	4	0	58	100	0.065	1
178.2	1	0	5	0	57	100	0.081	1
177.7	1	0	6	0	56	100	0.097	1
177.5	1	0	7	0	55	100	0.113	1

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173.7	1	0	8	0	54	100	0.129	1
173.4	1	0	9	0	53	100	0.145	1
173	1	0	10	0	52	100	0.161	1
170.7	0	1	10	1	52	99	0.161	0.99
170.2	1	0	11	1	51	99	0.177	0.99
170.1	1	0	12	1	50	99	0.194	0.99
169.4	1	0	13	1	49	99	0.210	0.99
168.3	1	0	14	1	48	99	0.226	0.99
168	1	0	15	1	47	99	0.242	0.99
167.2	1	0	16	1	46	99	0.258	0.99
166.5	0	1	16	2	46	98	0.258	0.98
166.4	0	1	16	3	46	97	0.258	0.970
166.2	1	1	17	4	45	96	0.274	0.960
166	1	0	18	4	44	96	0.290	0.960
165.7	0	1	18	5	44	95	0.290	0.950
164.8	0	1	18	6	44	94	0.290	0.940
164.7	1	0	19	6	43	94	0.306	0.940
164.6	1	0	20	6	42	94	0.323	0.940
163.7	0	1	20	7	42	93	0.323	0.930
162.4	1	0	21	7	41	93	0.339	0.930
162.2	0	1	21	8	41	92	0.339	0.920
161.9	1	0	22	8	40	92	0.355	0.920
161.3	0	1	22	9	40	91	0.355	0.910
161.2	0	1	22	10	40	90	0.355	0.900
161	1	0	23	10	39	90	0.371	0.900
160.7	1	2	24	12	38	88	0.387	0.880
160.2	1	0	25	12	37	88	0.403	0.880
160.1	0	1	25	13	37	87	0.403	0.870
160	0	1	25	14	37	86	0.403	0.860
159.9	0	2	25	16	37	84	0.403	0.840
159.5	1	0	26	16	36	84	0.419	0.840
159.1	1	0	27	16	35	84	0.435	0.840
158.9	0	2	27	18	35	82	0.435	0.820
158.6	0	1	27	19	35	81	0.435	0.810
158.1	1	1	28	20	34	80	0.452	0.800
157.9	1	0	29	20	33	80	0.468	0.800
157.8	1	0	30	20	32	80	0.484	0.800
157.6	1	1	31	21	31	79	0.500	0.790
157.5	1	0	32	21	30	79	0.516	0.790
157.1	1	0	33	21	29	79	0.532	0.790
157	0	1	33	22	29	78	0.532	0.780
156.8	0	2	33	24	29	76	0.532	0.760

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156.7	0	1	33	25	29	75	0.532	0.750
156.2	0	1	33	26	29	74	0.532	0.740
156	0	1	33	27	29	73	0.532	0.730
155.8	0	1	33	28	29	72	0.532	0.720
155.5	0	1	33	29	29	71	0.532	0.710
155.4	0	1	33	30	29	70	0.532	0.700
155.3	0	1	33	31	29	69	0.532	0.690
155.2	1	0	35	31	27	69	0.565	0.690
155.1	0	1	35	32	27	68	0.565	0.680
154.6	1	0	36	32	26	68	0.581	0.680
154.5	1	1	37	33	25	67	0.597	0.670
154.1	1	1	39	34	23	66	0.629	0.660
154	1	0	40	34	22	66	0.645	0.660
153.6	1	0	41	34	21	66	0.661	0.660
153.5	0	1	41	35	21	65	0.661	0.650
153.4	1	0	42	35	20	65	0.677	0.650
153.2	1	0	43	35	19	65	0.694	0.650
153.1	1	0	44	35	18	65	0.710	0.650
152.8	0	2	44	37	18	63	0.710	0.630
152.7	0	1	44	38	18	62	0.710	0.620
152.1	0	1	44	39	18	61	0.710	0.610
151.9	0	1	44	40	18	60	0.710	0.600
151.7	0	2	44	42	18	58	0.710	0.580
151.6	0	2	44	44	18	56	0.710	0.560
151	0	1	44	45	18	55	0.710	0.550
150.9	1	2	45	47	17	53	0.726	0.530
150.8	1	0	46	47	16	53	0.742	0.530
150.7	0	1	46	48	16	52	0.742	0.520
150.5	1	2	47	50	15	50	0.758	0.500
150.4	0	1	47	51	15	49	0.758	0.490
150.3	0	3	47	54	15	46	0.758	0.460
150.2	0	1	47	55	15	45	0.758	0.450
150	0	1	47	56	15	44	0.758	0.440
149.9	1	0	48	56	14	44	0.774	0.440
149.8	0	1	48	57	14	43	0.774	0.430
149.7	1	0	49	57	13	43	0.790	0.430
149.1	0	1	49	58	13	42	0.790	0.420
148.8	0	1	49	59	13	41	0.790	0.410
148.7	1	1	50	60	12	40	0.806	0.400
148.5	1	0	51	60	11	40	0.823	0.400
148.2	0	1	51	61	11	39	0.823	0.390
148.1	0	1	51	62	11	38	0.823	0.380
147.8	0	1	51	63	11	37	0.823	0.370

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147.6	0	2	51	65	11	35	0.823	0.350
147.4	0	1	51	66	11	34	0.823	0.340
147.3	0	1	51	67	11	33	0.823	0.330
146.6	1	0	53	67	9	33	0.855	0.330
146.5	0	2	53	69	9	31	0.855	0.310
146	1	0	54	69	8	31	0.871	0.310
145.9	0	1	54	70	8	30	0.871	0.300
145.8	1	0	55	70	7	30	0.887	0.300
145.7	1	0	57	70	5	30	0.919	0.300
145.6	0	1	57	71	5	29	0.919	0.290
145.2	0	1	57	72	5	28	0.919	0.280
145.1	0	2	57	74	5	26	0.919	0.260
145	0	1	57	75	5	25	0.919	0.250
144.8	0	2	57	77	5	23	0.919	0.230
144.7	1	0	58	77	4	23	0.935	0.230
144.5	0	1	58	78	4	22	0.935	0.220
144.3	0	2	58	80	4	20	0.935	0.200
144.2	0	1	58	81	4	19	0.935	0.190
143	0	1	58	82	4	18	0.935	0.180
142.9	1	1	59	83	3	17	0.952	0.170
142.5	1	0	60	83	2	17	0.968	0.170
142.3	1	0	61	83	1	17	0.984	0.170
142.2	0	1	61	84	1	16	0.984	0.160
141.8	0	1	61	85	1	15	0.984	0.150
141.6	0	1	61	86	1	14	0.984	0.140
140.8	0	1	61	87	1	13	0.984	0.130
140.5	0	1	61	88	1	12	0.984	0.120
140.2	0	1	61	89	1	11	0.984	0.110
139.9	0	1	61	90	1	10	0.984	0.100
139.2	0	1	61	91	1	9	0.984	0.090
139.1	0	2	61	93	1	7	0.984	0.070
137.9	0	1	61	94	1	6	0.984	0.060
137.8	0	1	61	95	1	5	0.984	0.050
137.4	1	0	62	95	0	5	1.000	0.050
135.3	0	1	62	96	0	4	1.000	0.040
134.4	0	1	62	97	0	3	1.000	0.030
133.1	0	1	62	98	0	2	1.000	0.020
129.8	0	1	62	99	0	1	1.000	0.010
127.1	0	1	62	100	0	0	1.000	0.000

Table 5: Statistics for all knees.

Upper groove angle below 140° (Figures 3,4) means patellar hyperstability but in this material it doesn't show that those patients are prone to develop pain if the anterior knee. In fact it's the opposite. Patellas in the deep groove are less movable medial-lateral than in the groove $>140^\circ$. This means that PFJ problems start with unstable patella not a hyperstable one.

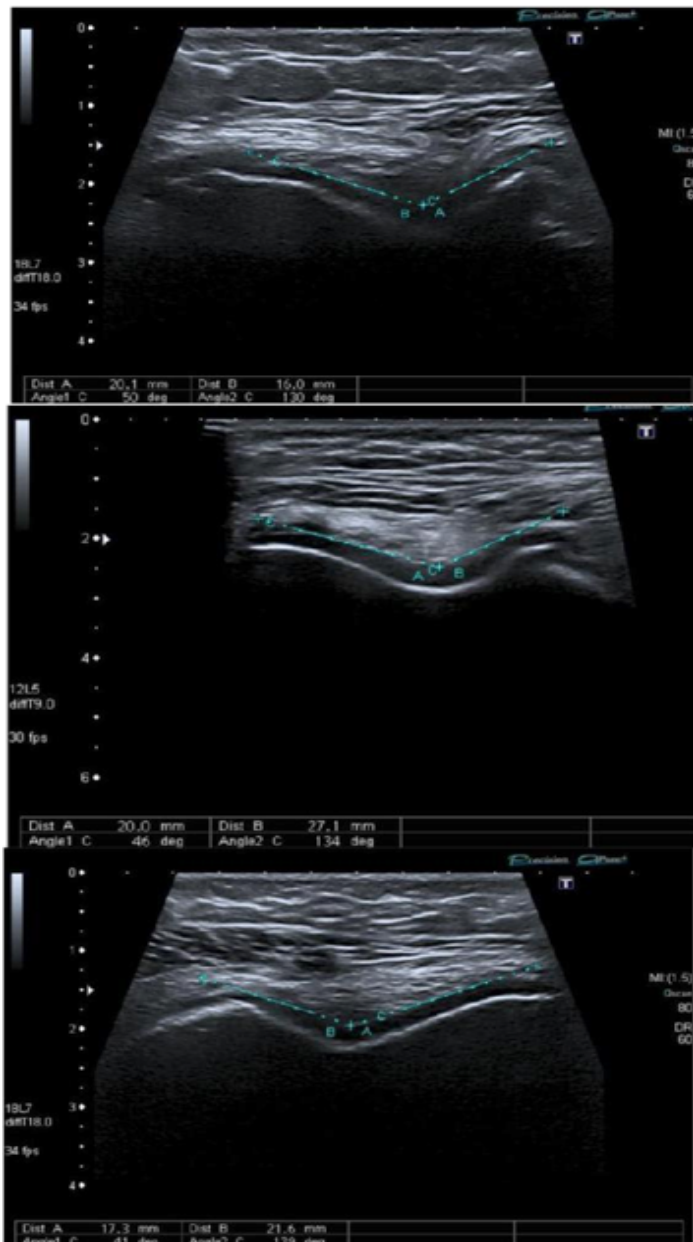


Figure 3: Transverse US scans over the upper femoral groove with angles below 140° . A very good prognosis for the knee.

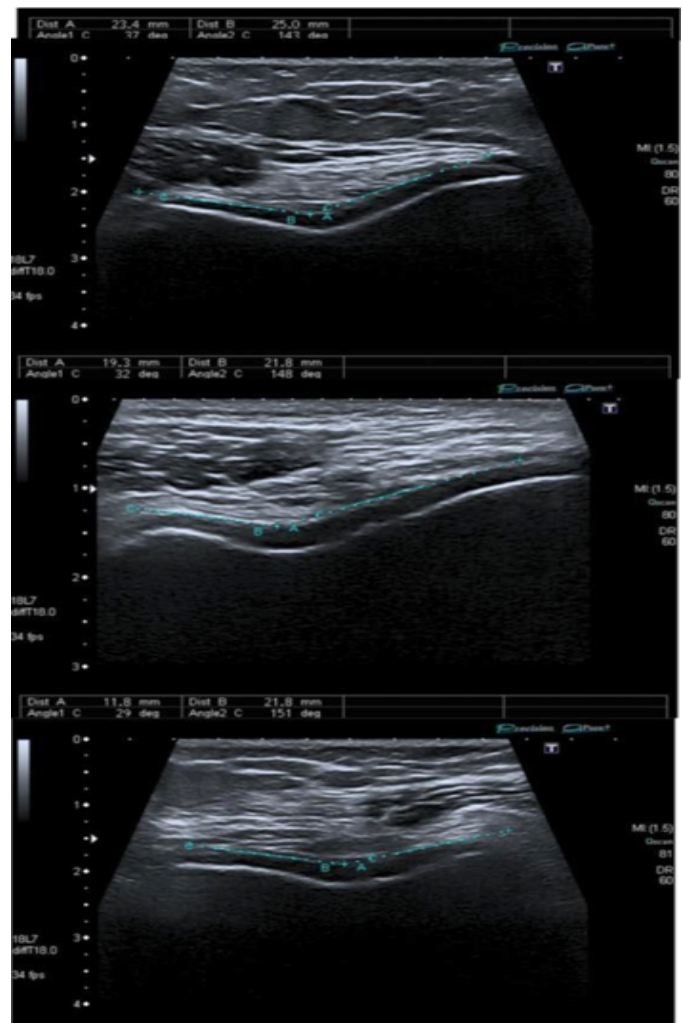


Figure 4: Transverse US scans over the upper femoral groove with angles of 140° - 160° . A very good prognosis for the knee. This is the angle range of most patients.

Patella in a danger of luxation has a groove above 170° (Figure 5). All three patients from the study who had an episode of patellar luxation had upper groove angle above 170° . If the upper femoral groove angle is high and that means it could have over 180° (flat or even convex) there is no bony stabilization of patella even if the patellar height is normal or even low.

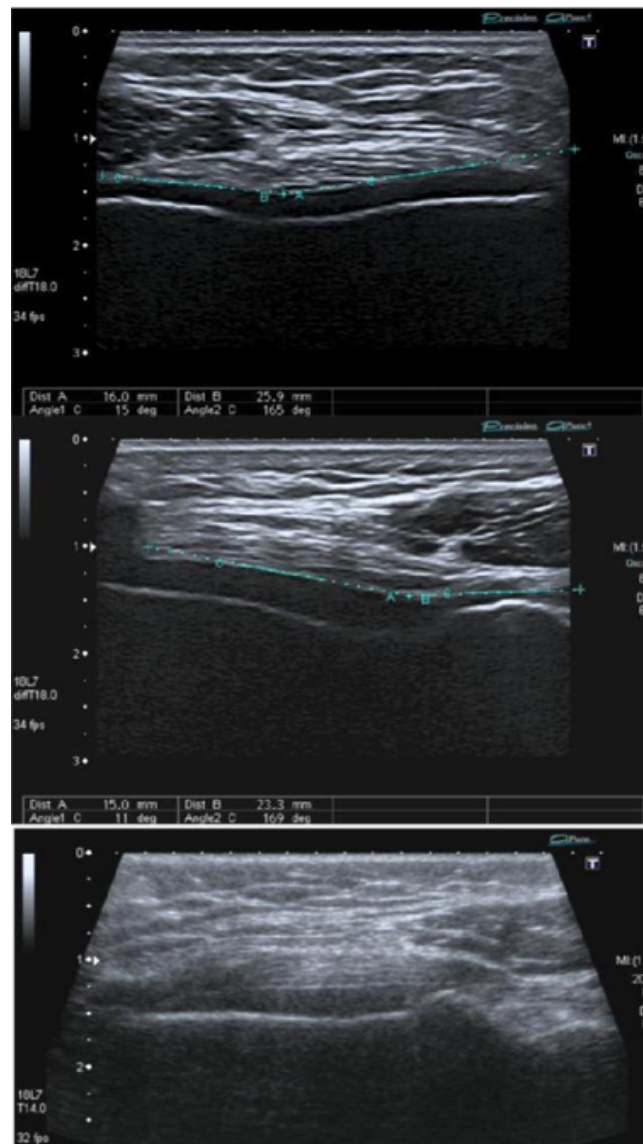


Figure 5: Transverse US scans over the upper femoral groove with angles of over 160°. A bad/uncertain prognosis for the knee. The lowest image without a measurement as it is plain flat.

Conclusions

The study indicates a high correlation between only one parameter of the patello-femoral joint (PFJ) and anterior knee pain. It is both the strength and the weakness of it. If a single parameter gives statistically important angle threshold in 162 measurements that means it is a valuable tool for evaluation of the PFJ's future. On the other hand there are combinations of many factors, of which the most important is the patellar height [1]. Three patients with patellar luxation in history had upper femoral cartilage groove angle $>170^\circ$. So it seems important to use this parameter as one of most important features of the patello-femoral joint. The femoral groove angle can also be measured in MRI and CT and the angle is sometimes the only clue to the knee problems.

Reference

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