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ARTHROSCOPY AND SPORTS MEDICINE

Characteristics and associated factors of Klee cartilage lesions: preliminary baseline-data of more than 1000 patients from the German cartilage registry (KnorpelRegister DGOU)

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Abstract
Introduction Knee cartilage lesions are very frequent in arthroscopic surgery. This multi-center-study was aimed to evaluate the distribution and possible associated factors of these pathologies in more than 1000 patients.
Materials and methods The German cartilage registry (KnorpelRegister DGOU) started in 2013. In this paper, we present the baseline-data (distribution of knee cartilage lesions and the demographic data) of more than 1000 cases since the registries' start-up.
Results A total number of 47 centers were involved into this multicenter study. A total of 1071 patients primary were registered. Degenerative knees 629 times (61.8 %) and injured knees 302 times (29.6 %) were involved. In the remaining 89 knees (8.7 %) the genesis of cartilage lesions was unclear. Single defects were observed in 792 cases (77.6 %). Most frequently the medial femoral condyle or the patella was affected. In 78 knees (7.6 %) the main-defect was associated with a defect of the corresponding joint surface. In the remaining cases complex cartilage damages were found.
Conclusions Our results are in confirmation with other multicenter studies. But these former studies did not differentiate into traumatic and degenerative lesions. Furthermore no characteristics were given regarding to single, kissing or complex lesions. Thus this database will be a sufficient instrument for the investigation of the "natural course" of cartilage lesions, but above all about the effectiveness of different treatment options.

Keywords Knee · Cartilage · Arthroscopy · Registry · Multicenter

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Introduction

Knee problems and knee-osteoarthritis are very frequent in general and in orthopaedic practice. It is undisputed that cartilage lesions mostly are involved in these pathological mechanisms. Cartilage lesions can affect all areas of the joint. This results in different distributions of these pathologies. The lesions can be occurring as "single defect" with intact margins as well as an intact corresponding joint-surface. "Kissing defects" are defined defects within corresponding areas. At least several areas of the joint can be affected (complex lesions, diffuse cartilage damage). From a pathophysiological view two general groups can be divided. The degenerative lesions do result from the chondrocyte-apoptosis and the catabolic processes in the chondral matrix. Major knee injuries instead can lead to chondral-crash or shear fragments. Other factors also can influence the occurrence of cartilage lesions, e.g. meniscus-tear, axial malalignment, instability [2, 4, 5, 15, 18].

For a better understanding of these mechanisms a systematic sampling of a large number of cases is needed. On

one hand, this can be made by multicenter studies as published in past [3, 10, 16, 20].

A systematic registration of better can be performed using standardised data records in a registry across a country [14]. Models for the effectiveness in medical research are the Scandinavian registers for arthroplasty or the Scandinavian ACL registers, founded over the last decades [6, 7, 11].

The German Cartilage Registry (KnorpelRegister DGOU) started in 2013 [12].

In this paper, we present the baseline dates (distribution of knee cartilage lesions and the demographic data) of more then 1000 cases since the registers start-up.

Methods

Registry and the data collection

The study design of the German Cartilage Registry (KnorpelRegister DGUO) detailed was described in a former paper [12]. The registry is conducted in accordance with the Declaration of Helsinki and registered at germanctr.de (DRKS00005671). To date 17 local ethic comities approved the registration of the implementation of the Cartilage Registry in a total of 47 centers so far. For the first author, this vote was given by the medical court of Thuringea (Jena, 226892/2014/10).

The patients were 18 years and older, and meet following criteria for participation: signed written informed consent, possession of a personal e-mail address, and surgical treatment of knee cartilage defect (grade III or IV accordingly to the ICRS Guidelines) [1].

Data collection was performed by using RDE light and sampled in the Center of Clinical Trials of the Freiburg University Hospital.

Statistical analysis

All statistical analyses were performed using SPSS version 20.0 (Chicago, IL, USA).

Continuous values are presented as mean (95 % CI, range). For a comparison of dichotomous parameters between the groups, Chi square was used. Continuous parameters were compared between the groups using the Mann–Whitney U test. A p value ≤ 0.050 was considered significant.

Results

Involved centers and quality of the registration

A total number of 47 centers were involved in this multicenter study. A total of 1071 patients primary were registered. The number of patients from each participating center ranged from 258 to 1 case within the time interval. The inter-center agreement was calculated from the data of the "leading centers" (ten and more cases). In respect to the frequency of cartilage lesions ($p = 0.735$), the patients age ($p = 0.817$), or history ($p = 0.358$) we did not find any difference.

A total of 51 (4.8 %) databases were incomplete. These patients had been excluded. Leading centers produced a significant lower quote of incomplete databases (23/653; 3.4 %) than the others (23/367; 6.4 %), $p = 0.006$.

Patients and preoperative findings

A total of 1020 patients (623 male, 397 female) underwent arthroscopic operation due to knee problems. The patients were 37.6 (95 % CI 36.8–38.9; range 12–74) years old. The history of knee pain or problems was 18.4 (95 % CI 17.2–19.6; range 0–99) months. With respect to the patients' gender there were no differences between age ($p = 0.156$) or history ($p = 0.724$).

A total of seven patients (0.7 %) declined a declaration of body masses. The remaining patients had a mean body mass index of 26.2 (95 % CI 25.9–26.7) kg/m^2. Accordingly to the WHO convention patients were classified as normal weight ($n = 449$; 44.0 %), overweight ($n = 339$; 38.5 %) and obese (171; 16.8 %).

There were 265 (26.1 %) smokers, 666 (65.3 %) 666 non-smokers (65.3 %), and 86 former-smokers (8.4 %). A total of three patients declined the declaration about their smoking habit (0.3 %). The frequency of smoking habits was without difference between male and female patients ($p = 0.433$).

Degenerative knees 629 times (61.8 %) and injured knees 302 times (29.6 %) were involved. In the remaining 89 knees (8.7 %) the genesis of cartilage lesions was unclear. A total of 451 patients did undergo primary operation (44.2 %). In 31.0 % ($n = 316$) and in 14.1 % ($n = 144$) this arthroscopy was the second, respective third operation. The other 109 patients (10.7 %) had undergone three or more operations (maximum nine) in the past. Revision cases reported about a significant longer history than primary operations ($p < 0.001$). There were no differences between primary cases and revision cases regarding to age ($p = 0.051$), genesis ($p = 0.362$), defect pathology ($p = 0.172$), or other associated factors.

A total of 689 (67.3 %) had a normal alignment of leg axis. A varus deformity was stated in 20.8 %, and a valgus in 6.1 %. In 5.9 % the observers were not able for a statement of the alignment. In 48.8 % the meniscus was described as intact.

Frequency and distribution of the cartilage lesions

Single defects were observed in 792 (77.6 %). Most frequently the medial femoral condyle or the patella was affected. In 78 knees (7.6 %) the main defect was associated with a defect of the corresponding joint surface. In the remaining cases complex cartilage damages were found (Table 1; Fig. 1).

Characteristic and associated factors of single defects

There was a significant higher frequency of single patellar defects in the injured knees than in the degenerative or other knees ($p < 0.001$). No single defect was observed within the lateral condyle.

Regarding axial malalignment, a pathological varus significantly was associated more frequently with single defects of the medial condyle (27.4 %). Patients who demonstrated a single lateral tibial defect more frequently showed a valgus deformity ($p < 0.001$).

In knees with patella defects (16.3 %) and trochlea defects (26.8) % the meniscus was frequently intact. Defects of the medial condyle (49.9 %), the medial tibia (55.1 %), or the lateral tibia (56.3 %) occurred significantly more frequent with a concomitant meniscus tear.

The diameters of the defects are listed in Table 2. There were no relations between the defect diameter and gender ($p = 0.553$), smoking habits ($p = 0.749$), or axial alignment ($p = 305$).

Patients who did undergo revision arthroscopy (353.4 mm^2) demonstrated significant higher diameter compared to primary operations (311.9 mm^2), $p = 0.023$. The traumatic and degenerative defects had a similar diameter. In contrast defects with an unclear/other genesis were significantly enlarged ($p < 0.001$). No correlation was found between defect size and age ($p = 0.539$), BMI ($p = 0.819$), or history ($p = 0.575$).

Characteristics and associated factors of kissing lesions

All defects of the lateral condyle were classified as kissing or complex lesion.

Kissing lesions were significantly ($p = 0.041$) caused by degeneration in 78.2 %: patellofemoral 57.1 %, medial compartment 88.0 %, and lateral compartment 71.4 %.

The clinical axial alignment of the leg was a significant associated factor with the occurrence of kissing lesions ($p < 0.001$). Within the patella subgroup 84.2 % had a neutral alignment, 10.5 % a varus- and 5.3 % a valgus deformity. Medial compartment defects were associated with a neutral axis in 12.2 %. In 85.7 % a varus was evaluated, and in 2.1 % a valgus deformity. In the lateral compartment in 42.9 % a straight axis, in 28.6 % a varus, and in 28.6 % a valgus was present.

In knees with patello-femoral defects (16.9 %) the meniscus was frequently intact. Defects of the medial compartment (83.7 %), or the lateral compartment (57.1 %) are significantly more frequent with a concomitant meniscus tear ($p < 0.001$).

The diameters of the defects are listed in Table 3. There were no relations between the defect diameter and gender ($p = 0.689$), smoking habits ($p = 0.533$).

Table 1 Frequency and distribution of the cartilage lesions

	All		Injury		Degeneration		Other/unclear	
	n	%	*n*	%	*n*	%	*n*	%
	1020		302		629		89	
Single defect patella	229	22.5	100	33.1	119	18.9	10	11.2
Single defect trochlea	88	8.6	23	7.6	59	9.4	6	6.7
Single defect medial condyle	359	35.2	97	32.1	208	33.1	54	60.7
Single defect medial tibia	100	9.8	29	9.6	61	9.7	10	11.2
Single defect lateral tibia	16	1.6	3	1.0	12	1.9	1	1.1
Kissing lesion PF	21	2.1	9	3.0	12	1.9		
Kissing lesion medial	50	4.9	6	2.0	44	7.0		
Kissing lesion lateral	7	0.7	2	0.7	5	0.8		
Kissing lesion PF + single defect	6	0.6	3	1.0	3	0.5		
Kissing lesion medial + single defect	7	0.7	1	0.3	7	1.1		
Kissing lesion lateral + single defect	4	0.4	14	4.6	3	0.5		
Two single defects	76	7.5	3	1.0	58	9.2	4	4.5
Three single defects	26	2.5	4	1.3	21	3.3	2	2.2
Other/no specification	14	1.4	8	2.6	10	1.6		
Single defect/no specification	17	1.7			7	1.1	2	2.2

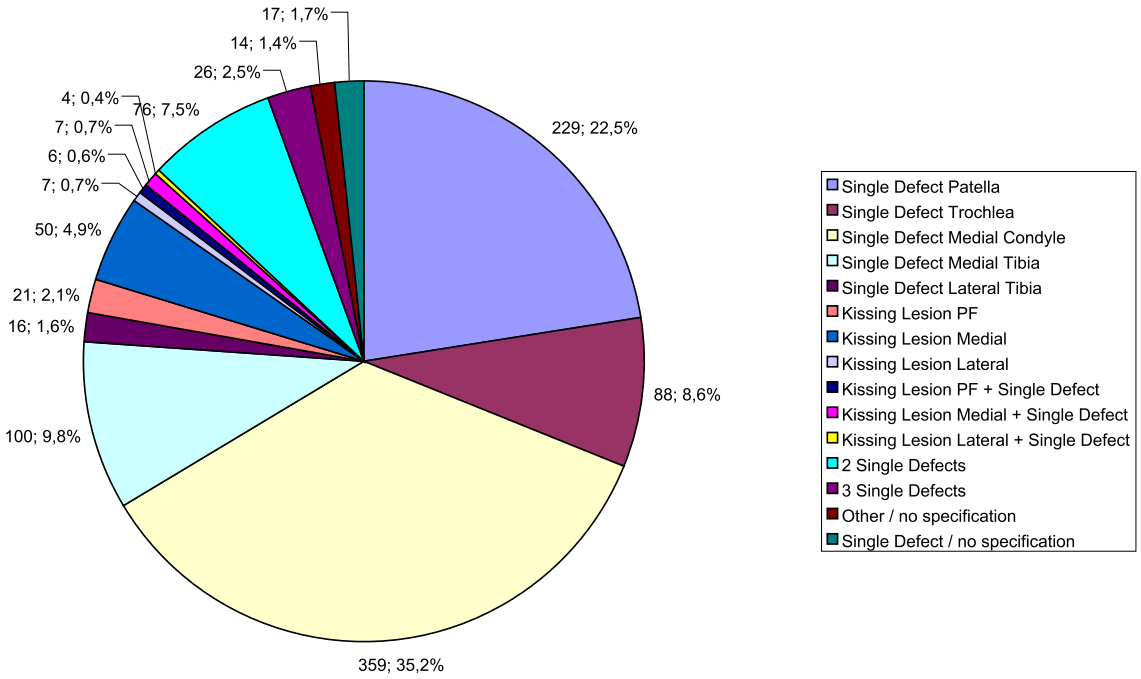

Fig. 1 Frequency and distribution of the cartilage lesions

There was no difference in the frequency of kissing lesions regarding to revision operation (0.954).

The occurrence of kissing lesions and the defect sizes did not depend on the number of revisions or the duration of symptoms. A weak correlation was found between BMI and size of the defects ($R^2 = 0.291$, $p = 0.011$). No correlation was found between defect size and age ($p = 0.379$) or history ($p = 0.302$).

Table 2 Single defects

	Diameter (mm^2)
Patella	309.1 (95 % CI 282.9–335.2)
Trochlea	311.8 (95 % CI 271.1–352.6)
Medial condyle	366.1 (95 % CI 393.2–392.9)
Medial tibia	291.6 (95 % CI 249.8–333.4)
Lateral tibia	256.4 (95 % CI 169.9–517.3)

Characteristics and associated factor of the complex lesions

The distribution of the 133 (13 %) is listed in Table 1 and Fig. 1. The complete affected joint surface was 854.2 (95 % CI 252.2–1456.2; range 103–3740) mm^2. There was a high heterogeneity is this group. An analysis of associated factors was not possible.

Discussion

We present the first series of the German Cartilage Registry (KnorpelRegister DGOU). This register is the worldwide first and only database in this field of investigation [12].

The study was performed to determine the distribution and characteristics of knee cartilage lesions in a large number of patients.

Table 3 Kissing lesions

	Diameter (mm^2) defect I[a]	Diameter (mm^2) defect II[b]	Diameter (mm^2) defect I and II
Patello–femoral	248.1 (95 % CI 169.9–326.2)	292.2 (95 % CI 173.9–410.5)	540.3 (95 % CI 389.6–691.1)
Medial compartment	430.5 (95 % CI 354.8–506.1)	270.9 (95 % CI 207.9–393.9)	702 0 (95 % CI 587.7–816.4)
Lateral compartment	245.7 (95 % CI 70.1–421.3)	167.6 (95 % CI 81.3–316.9)	413.3 (95 % CI 137.8–688.8)

[a] Defect I = patella or medial/lateral condyle

[b] Defect II = trochlea or medial/lateral tibia

Registers are a very valuable instrument in the reflection of the real situation treatment.

For different diseases many registers had been developed in the past (e.g. general national patient or disease register, cancer registers or special registers for special diseases).

Models for the evaluation in the orthopaedic surgery were the Scandinavian countries. The Scandinavian Arthroplasty Registers were founded in the 70th decades of the last century. The Scandinavian ACL Registry started in 2004 in Norway 2005 in Sweden and Denmark. In these countries about 70–90 % of all occurring ACL case are sampled.

The advantage is the simple inclusion of numerous patients from many centers. This makes it possible to achieve a high statistical power. The main disadvantages against is the large heterogeneity regarding the patients parameter and the bias regarding the different centers.

Thus this evaluation has some strong limitations.

This is the preliminary report about the first series from more than 1000 patients who were included into the German Cartilage Registry (KnorpelRegister DGOU). The registry will be continuing over the next years. Only patients who did undergo cartilage surgeries were registered. That causes a lack of controls. In the current algorithms only three defects/lesions were registered. There is a lack of information about the none-affected or mild-affected joint compartments. The importance of the evaluated associated factors is still unclear.

Furthermore the participation of centers is on a voluntary basis. This can be explained by the structure of the German health system. There are a large numbers of different health insurances, different maintenances of medical institutions (e.g. public, clerical or private hospitals), and last but not least a strict division between hospital and outpatient medicine. Furthermore because of the federalist German structures the implementation of a national register is associated with a large number of problems. Still the inserts of the arthroscopic centers for a participation in the registry had been enlarged since the start-up.

These results confirm the knowledge about the frequency and distribution of deep cartilage lesions/defects in a large number of arthroscopies.

In a majority (61.8 %) the cartilage lesions were caused by a degenerative genesis. The aspect of occurrence in the "degenerated knee" is strengthened because of the significant higher incidence of "kissing lesions or complex lesion" and a concomitant meniscus tear. Furthermore the localisation within the "main bearing zone" of the medial condyle reflects this.

Single lesions are more frequently associated with an adequate knee injury. The higher frequency of single patellar lesions in injured knees may be an index for the history of a patella dislocation.

Our results are in confirmation with other multicenter studies [2, 3, 9, 10, 16, 19]. But these former studies did not differentiate into traumatic and degenerative lesions. Furthermore characteristics regarding single, kissing or complex lesions were not given. We are sure our results are reflecting the real situation about the frequency and distribution of cartilage lesions in routine arthroscopies. The study design is prospective. All patients will be evaluated after 6, 12, 24, 36, 60 and 120 months postoperatively using standardised instruments (KOOS, IKDC) [8, 13]. Thus this database will be a sufficient instrument for the investigation of the "natural course" of cartilage lesions, but above all about the effectiveness of different treatment options [4, 5, 17].

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