Short-Term Effects of Different Arthroscopic Techniques in the Treatment of Chondral Defects (Shaving, Coblation, and Microfracturing)

Gunter Spahn, Ralf Wittig[1]

Abstract

Background and Objective: Arthroscopic treatment of chondral defects includes different techniques. This study is intended to compare the short-term effects of mechanical shaving, electrosurgical coblation, and microfracturing.

Patients and Methods: In 123 patients suffering from medial arthrosis of the knee joint, an arthroscopy was performed. Evaluation included determination of the Lysholm score and measurement of pain by a visual analog scale (VAS). In 47 patients, the chondral defects were shaved mechanically (group A). 32 patients underwent electrosurgical coblation (group B). In 44 patients, the chondral defects were subjected to microfracturing according to Steadman et al (group C).

Results: At follow-up after a period of 20.1 months, the Lysholm score had increased from 31.5 ± 27.4 to 60.4 ± 13.8 points ($p < 0.05$). Pain was reduced from 61.5 ± 25.6 to 28.4 ± 19.1 ($p < 0.05$). No differences were seen between the groups.

Conclusion: The results suggest that the differences between the methods of chondral treatment are only marginal. Due to the mostly poor outcome, the indication for arthroscopic treatment of gonarthrosis should be viewed critically.

Key Words
Chondral defects · Arthroscopy · Shaving · Coblation · Microfracturing · Gonarthrosis

Eur J Trauma 2002;28:349–54
DOI 10.1007/s00068-002-1225-9

Introduction

Idiopathic and posttraumatic osteoarthritis of the knee (gonarthrosis [GA]) is of great importance in traumatologic and orthopedic surgery. The high prevalence of the disease requires effective treatment. In moderate GA, joint-sparing operations using arthroscopy are the methods of choice. In 1941, Magnuson [13] has established the method of joint debridement ("housecleaning"). It includes lavage, resection of the destroyed meniscus, extraction of loose bodies, synovectomy, and resection of exophytes. Nowadays, housecleaning is mostly performed arthroscopically.

The question most controversially discussed in joint-sparing treatment of GA concerns the most effective (both medically and economically) therapy of chondral defects. Innumerable different methods of treatment have been developed.

On the one hand, methods of smoothing chondral defects are common. These techniques, using mechanical instruments (shaver systems, punches, files), laser technologies or electromagnetic radiofrequency energy [17], must be regarded as symptomatic therapy only. Chondral debridement is intended to produce mechanically stable joint areas and to reduce the formation of loose bodies and of chondrodendritic synovitis.

Frequently, debridement of chondral defects leads to a reduction of pain and swelling as well as an improvement in function and range of motion (60–80% of all cases). The positive therapeutic effect is often temporally limited; patients usually benefit for an average of 2–5 years. After this period, progression of the arthrotic process with concomitant persistent discomfort is observed in most patients.

[1] Praxisklinik Eisenach, Germany.

Received: May 31, 2002; revision accepted: October 29, 2002

Schneider et al [19] found good results in only 5.5% after 10 years. The importance of this method consists in the avoidance of an endoprosthesis over a limited period, from which especially younger patients profit.

On the other hand, surgical techniques for reconstruction of the destroyed articular surface exist. Drilling according to Pridie [15], abrasion chondroplasty [4], and microfracturing according to Steadman et al [22] aim at inducing the production of fibrous chondral regenerates. Mechanical alteration of the subchondral bone stimulates the mesenchymal stem cells. Through this, chondral regenerates arise. These regenerates contain collagen I. These regenerates possess inferior mechanical properties and are less durable than hyaline cartilage.

The transplantation of osteochondral cylinders according to Hangody et al [7] represents a possible option in limited chondral defects. Disadvantages of this method are the destruction of healthy articular surface during graft harvesting and the limitation to small chondral defects. A seldom performed method is the transplantation of periosteal flap grafts alone [2, 10].

Autologous chondrocyte transplantation will certainly develop in the future [5]. Peterson et al [18] reported good results in a small collective of young patients (n = 25; mean age 32.2 years). At present, this method involves numerous problems and substantial cost and is therefore only used in controlled studies. Limitations of all chondral stimulation and chondral replacement operations are the patient's age, the degree of GA, sclerosis of the subchondral bone, and accompanying lesions such as ligamentous or meniscal tears, axial devuation of the leg and massive muscular deficit.

This study was intended to investigate the effectiveness of three established methods in arthroscopic GA therapy: chondroshaving, bipolar vaporization, and microfracturing.

Patients and Methods

Patients (n = 123) suffering from idiopathic arthrosis of the medial knee compartment underwent arthroscopy. None of them had been operated on before. The chondral damages of the medial femoral condyle ranged between III° and IV° according to the classification by Outerbridge [16]. The patients did not show any lesions of the patellar joint space or the lateral joint compartment nor massive injuries in their medical history. The ligaments were intact. Patients receiving additional treatment (synovectomy, extraction of exophytes or loose bodies, operation of ligaments) were excluded from this study.

In tears of the medial meniscus (n = 104), a partial or subtotal resection was performed. In group A (n = 47), the medial condyle was shaved mechanically. Group B (n = 32) underwent electrosurgical treatment (bipolar vaporization). In the remaining patients (group C, n = 44), the chondral defect was microfractured according to Steadman et al [22], to stimulate fibrous cartilage.

The surgeon made the decision on shaving (group A) or coblation (group B) intraoperatively, in dependence on the individual situation and availability of instruments. By contrast, microfracturing (group C) was planned and the longer rehabilitation period discussed with the patient.

The patients' data are shown in Table 1.

Surgical Technique and Rehabilitation Program

All operations were performed by the senior author himself or with his assistance, with the patients in general anesthesia. A tourniquet was always used. The joints were filled with sodium chloride solution under controlled inflow and pressure by an automatic pump.

In group A, an arthroscopic shaver system (arthrex®, USA) was used. Bipolar chondroplasty in group B was done by means of a coblation probe (arthrocare®, Europe, Stockholm, Sweden). Microfracturing in group C was performed by micropicks (arthrex®, USA) after radical debridement of the defect. A Redon drain was obligatory in all cases.

All patients received nonsteroidal antirheumatic drugs (Ibuflam 800 mg) and prophylactic medication with low molecular weight heparin (Fraxiparin) until the 10th postoperative day.

The patients in groups A and B were allowed to use their leg without any limitations. Patients in group C

Table 1. Patients.

	Group A	Group B	Group C
Number of patients	47	32	44
Sex (male/female)	19/28	15/17	28/16
Age (years)	55.9 ± 11.9* (52.4–59.4)	46.0 ± 11.9 (41.7–50.3)	45.4 ± 12.8 (41.5–49.3)
Side (right/left)	23/24	16/16	26/18
Time between operation and follow-up (months)	20.9 ± 2.2 (20.3–21.6)	19.9 ± 2.3 (19.1–20.7)	19.9 ± 2.1 (19.3–20.5)
Operating time (min)	11.9 ± 7.9 (9.6–14.1)	29.8 ± 21.4* (22.1–37.5)	20.0 ± 16.4 (15.0–25.0)

*significant ($p < 0.05$)

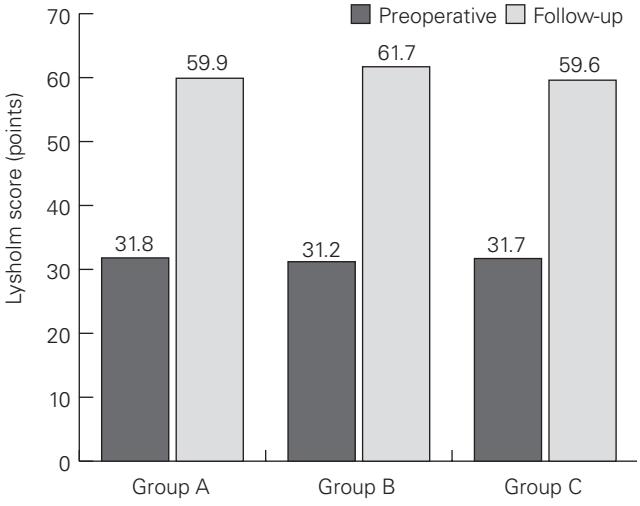

Figure 1. Lysholm score. There were no significant differences between the groups.

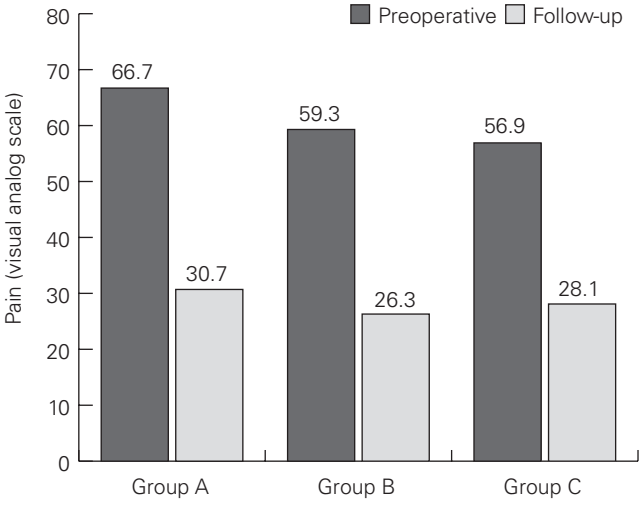

Figure 2. Quantification of pain on the visual analog scale (VAS). In all groups, pain was significantly reduced at the time of follow-up.

had to relieve the operated leg for 4 weeks. These patients were treated with continuous passive motion up to the 4th week.

The rehabilitation program constisted of aggressive physical exercises including aqua-jogging, electrotherapy, and lymphatic drainage.

Analysis

The patients' subjective discomfort was determined preoperatively and at follow-up using the Lysholm score [12]. The score values were classified as follows: good 80–105 points; moderate 60–79 points; poor 0–59 points [9].

The intensity of pain was assessed by means of a visual analog scale (VAS) ranging from 0 = no pain to 100 = insufferable pain.

Values are given as mean ± standard deviation (confidence interval). Statistical analysis was performed by using the t-test (comparison within the groups) and analysis of variances (ANOVA) to evaluate differences between treatment groups. The χ^2 test was used to compare frequencies. Differences were considered significant at $p < 0.05$ (two-sided).

Results

The groups were comparable. Patients in group A were older than those in groups B and C.

Arthroscopic operation led to a significant reduction of the patients' discomfort. The Lysholm score of all patients decreased significantly from 31.5 ± 27.4 (26.5–36.4) to 60.4 ± 13.8 (58.0–62.9).

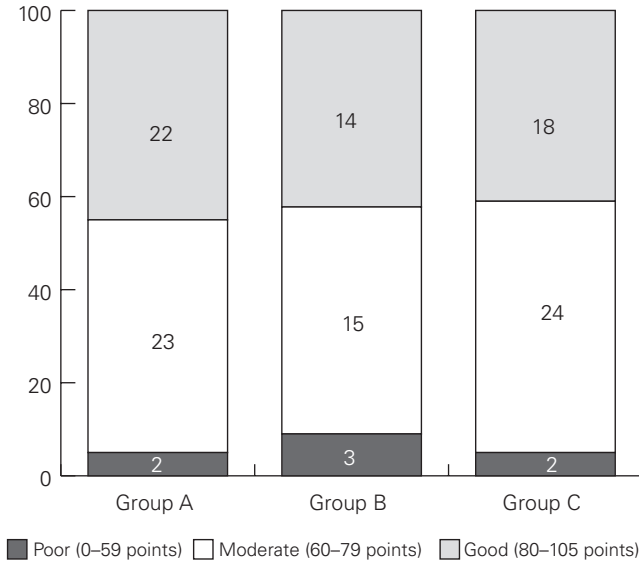

Figure 3. Distribution of good, moderate and poor results in dependence on chondral therapy. No significant differences between the groups were observed.

The reduction of pain was determined on the VAS. The values of all patients amounted to 61.5 ± 25.6 (56.9–66.1) preoperatively and to 28.4 ± 19.1 (25.0–31.8) at the time of follow-up ($p < 0.05$).

No significant differences were seen between the groups concerning Lysholm score and reduction of pain (Figures 1 and 2). The results were good in seven patients (5.7%). Moderate results were found in 62 patients (50.4%), whereas 54 patients (43.9%) showed a poor outcome. The differences between the groups

were not significant (Figure 3). The same goes for the different parameters of the Lysholm score (Table 2).

In 25 cases (20.2%), the operation was ineffective (difference in Lysholm score < 10 points). No significant differences regarding these irresponsive patients were seen between the groups: A: 17.0%; B: 25.0%; C: 18.7%.

In 16 cases (13.1%), pain was not reduced (< 10 points on VAS). These nonresponders were seen as follows: group A: six (12.8%); group B: six (18.8%); group C: nine (20.5%). The difference between groups A and C was significant.

A correlation between demographic data (age, sex) or the degree of chondral damage (femoral or tibial), the additional meniscal tear as well as the Lysholm score and the intensity of pain, respectively, was not observed (Table 3).

Table 2. Detailed parameters of the Lysholm score. For all parameters, a significant improvement in subjective discomfort was seen. On the other hand, there were no significant differences between the groups.

	Group A		Group B		Group C	
	Preoperative	Follow-up	Preoperative	Follow-up	Preoperative	Follow-up
Limp	2.1 ± 1.8 (1.6–2.6)	3.3 ± 1.4 (2.9–3.7)	2.0 ± 2.0 (1.2–2.7)	3.5 ± 1.6 (2.9–4.1)	1.9 ± 1.8 (1.3–2.4)	3.6 ± 1.3 (3.1–3.9)
Use of support	3.4 ± 2.2 (2.8–4.1)	4.1 ± 1.6 (3.6–4.6)	3.0 ± 2.4 (2.1–3.8)	4.2 ± 1.4 (3.6–4.7)	3.1 ± 2.3 (2.3–3.8)	4.3 ± 1.3 (3.9–4.7)
Movement	3.0 ± 3.9 (1.8–4.1)	6.2 ± 4.8 (4.8–7.6)	3.1 ± 4.6 (1.5–4.7)	5.5 ± 5.1 (3.6–7.3)	3.1 ± 4.3 (1.8–4.3)	6.0 ± 4.4 (4.6–7.3)
Giving way	11.8 ± 9.5 (9.0–14.6)	16.4 ± 6.5 (14.5–18.3)	8.6 ± 9.9 (5.0–12.2)	16.0 ± 6.6 (13.5–18.3)	9.2 ± 10.0 (6.2–12.2)	15.2 ± 7.0 (13.1–17-4)
Pain	4.8 ± 7.6 (2.5–7.0)	18.6 ± 6.7 (16.7–20.6)	7.6 ± 9.5 (4.1–11.0)	19.8 ± 7.7 (17.1–22.6)	6.4 ± 8.3 (3.8–8.9)	20.4 ± 6.2 (18.5–22.4)
Swelling	2.9 ± 3.7 (1.8–4.0)	5.6 ± 3.0 (4.7–6.4)	3.3 ± 3.9 (1.8–4.7)	5.4 ± 2.9 (4.4–6.5)	2.9 ± 3.6 (1.8–4.1)	5.9 ± 2.7 (5.0–6.7)
Stair climbing	2.7 ± 3.2 (1.7–3.6)	3.1 ± 2.5 (2.4–2.9)	2.2 ± 2.8 (1.1–3.2)	2.8 ± 2.6 (1.8–3.7)	3.3 ± 3.7 (2.2–4.4)	3.6 ± 3.0 (2.7–4.5)
Squatting	1.7 ± 2.0 (1.1–2.3)	2.6 ± 1.8 (2.1–3.1)	1.9 ± 2.0 (1.2–2.6)	2.5 ± 1.9 (1.7–3.2)	1.9 ± 2.0 1.3–2.5)	2.7 ± 1.9 (2.1–3.2)

The complication rate amounted to 6.6%. No significant differences between the groups could be observed. These data are listed in Table 4.

No patient has been submitted to revision surgery to date.

Discussion

Arthroscopy is an established method in moderate GA. In 1934, Burmann et al [3] reported on the positive effect of lavage in GA treatment. Magnuson [13] developed the "housecleaning" of the joint including meniscal resection, debridement of chondral defects, resection of exophytes, and partial or subtotal synovectomy. Today, arthroscopic "housecleaning" is the method of choice in cases of moderate GA [21]. In general, this operation belongs to the most frequently performed traumatologic and orthopedic interventions.

It is obvious that only patients with mild or moderate GA can be treated successfully. Moreover, it is undisputed that these operations often lead to a short- or medium-term success only. Furthermore, no effect can be seen in about 20% of the patients.

While the technique of meniscus resection, extraction of loose bodies and exophytes is standardized, possible methods in the treatment of chondral defects are discussed controversially. The spectrum of potential measures includes debridement (mechanical, laser, or electrosurgical), generation of fibrocartilaginous regenerates (drilling, abrasion, or microfracturing), and chondral grafting (osteochondral cylinder or chondrocyte transplantation).

In this study, we have determined the effects of three different treatments of unicompartmental medial GA. To exclude possible mistakes, only patients showing degenerative changes without ligament lesions were analyzed. The arthrotic process was confined to the medial joint space. This study is limited by its retrospective and nonrandomized design.

The groups were fundamentally comparable (Table 1). Patients in group A were older than the rest. This is substantiated by the limited use of microfracturing in older patients. The longer duration of surgery in group B was due to electrosurgical meniscal resection requiring more time than mechanical resection.

Arthroscopic joint debridement led to a significant increase in the Lysholm score. On the other hand, differences between the groups could not be observed. The single parameters of the Lysholm score were also analyzed (Table 2).

Pain reduction, expressed in points on the VAS, was also significant in each group. However, this was possibly due to the positive effect of electrosurgery producing a "sealing" of chondral defects [23]. Lüb-

Table 3. Influence of demographic data, medial meniscal tear and degree of chondral damage on subjective discomfort. There were no differences between the groups. VAS: visual analog scale.

	Lysholm score		Pain (points on VAS)	
	Preoperative	Postoperative	Preoperative	Postoperative
	Age			
Age < 40 years (n = 29)	30.7 ± 32.8 (18.2–43.2)	62.7 ± 15.2 (60.0–68.5)	59.2 ± 26.8 (49.0–69.4)	27.3 ± 20.9 (19.4–35.0)
Age 40–60 years (n = 64)	33.4 ± 24.4 (27.2–39.4)	59.5 ± 11.7 (56.5–62.4)	63.7 ± 25.5 (57.3–70.1)	29.7 ± 19.0 (25.0–34.5)
Age > 60 years (n = 30)	28.5 ± 28.4 (17.9–39.1)	60.4 ± 16.6 (54.2–66.6)	59.0 ± 25.1 (49.6–68.4)	26.8 ± 17.8 (20.1–33.4)
	Sex			
Male (n = 62)	35.7 ± 29.2 (27.7–42.5)	61.9 ± 13.6 (58.4–65.3)	59.7 ± 26.2 (53.1–66.4)	29.7 ± 21.7 (24.2–35.3)
Female (n = 61)	27.9 ± 25.1 (21.4–34.3)	59.1 ± 14.1 (55.5–62.7)	63.3 ± 25.1 (56.9–69.7)	27.1 ± 16.1 (22.9–31.2)
	Meniscal tear			
Tear (n = 104)	31.2 ± 27.3 (25.9–36.6)	60.2 ± 13.9 (57.5–62.9)	61.9 ± 25.4 (56.9–66.8)	28.2 ± 18.7 (24.6–31.9)
No tear (n = 19)	33.2 ± 28.4 (19.4–46.9)	61.8 ± 13.6 (55.3–68.4)	59.4 ± 27.5 (46.2–72.7)	29.6 ± 21.6 (19.1–40.1)
	Chondral damage of the medial femoral condyle			
III° (n = 87)	33.7 ± 27.1 (24.9–36.4)	59.9 ± 13.6 (56.9–67.7)	61.5 ± 25.3 (56.1–66.9)	29.9 ± 19.6 (25.7–34.1)
IV° (n = 36)	33.7 ± 28.2 (24.1–43.2)	62.0 ± 14.5 (57.1–66.9)	61.5 ± 26.7 (52.4–70.5)	24.9 ± 17.6 (18.9–30.8)
	Chondral damage of the medial tibial plateau			
None (n = 19)	24.6 ± 30.2 (10.1–39.2)	59.2 ± 13.7 (52.5–65.7)	68.7 ± 23.7 (57.2–80.1)	32.2 ± 22.2 (21.4–42.8)
I° (n = 21)	42.0 ± 28.5 (28.9–54.9)	63.7 ± 14.9 (56.9–70.4)	57.4 ± 30.2 (43.6–71.2)	27.8 ± 16.4 (20.3–35.2)
II° (n = 40)	28.4 ± 25.6 (20.1–36.5)	60.2 ± 10.9 (56.7–63.7)	58.9 ± 26.9 (50.2–67.4)	25.9 ± 15.3 (21.0–30.8)
III° (n = 20)	28.8 ± 25.9 (16.6–40.9)	60.1 ± 18.7 (51.3–68.9)	69.6 ± 23.2 (58.7–80.4)	28.9 ± 17.6 (20.6–37.2)
IV° (n = 23)	35.7 ± 27.2 (23.9–47.5)	59.5 ± 13.3 (53.7–65.2)	57.0 ± 21.1 (47.8–66.1)	30.0 ± 25.8 (18.8–41.2)

Table 4. Complications. There was no significant difference in the total rate of complications. The differences in the frequency of effusion and of deep vein thrombosis in the different groups were not significant. Deep vein thrombosis was limited to the legs. Treatment with Fraxiparin was adequate.

	Group A		Group B		Group C	
	n	%	n	%	n	%
Effusion requiring aspiration	1	2.1	1	3.3	3	6.8
Deep vein thrombosis	1	2.1	2	6.6	0	0
Total	2	4.2	3	10.0	3	6.8

bers & Siebert [11] observed better results following thermoablation of the meniscus in comparison with mechanical resection. Other investigators also reported a better outcome when using electrosurgical or laser treatment as compared to conventional mechanical shaving [6, 17].

On the whole, there were no differences between the groups. The results (Lysholm score of about 60 points) have to be considered moderate as reported by other investigators [8]. The differences between the various methods of chondral treatment do not seem to influence the outcome.

The complete ineffectiveness of the operation in about 10–20% of the patients must also be viewed critically. It is remarkable that this rate was significantly higher in group C. The same ratio was observed by Steadman et al [22]. The method of microfracturing aims at producing chondral regenerates. The results of Steadman et al, however, show a better outcome in the 8-year follow-up. Hence, this method should be used especially in young patients.

The analysis of the results suggests that not only the degree of chondral damages affects the outcome. The possible factors that were evaluted did not influence the result. Here, other causes such as muscular and proprioceptive deficits [1], shrinkage of capsule, synovialitis, and obesity may play a role.

Our results suggest that arthroscopic treatment of medial GA leads to a moderate improvement in discomfort. On the other hand, both surgeon and patient must judge the potential benefit realistically. In a controlled study, Moseley et al [14] found no differences between patients undergoing arthroscopic debridement and a placebo group.

Since the differences between mechanical shaving, bipolar chondral coblation and microfracturing are neg-

ligible, the method involving a minimum of risks, short operating time and low cost should be selected. With regard to the good results of Steadman et al, microfracturing should only be used in young patients. Here, a better long-term result can be expected, if possible in combination with high tibial osteotomy [20]. In older patients, however, methods not requiring with long rehabilitation periods should be used. Here, chondral debridement is safe. It seems that bipolar electrosurgical treatment is of minor benefit. In severe chondral damage, older patients with pan-gonarthrosis and in case of recurrent discomfort, arthroscopic treatment must be seen very critically.

References

1. Barret DS, Cobb AG, Bentley G. Joint proprioception in normal, osteoarthritic and replaced knees. J Bone Joint Surg Br 1991;73: 53–6.
2. Bruns J, Steinhagen J. Transplantation chondrogener Gewebe zur Behandlung von Gelenkknorpeldefekten. Orthopäde 1999;28:52–60.
3. Burmann MS, Finkelstein H, Mayer L. Arthroscopy of the knee. J Bone Joint Surg Br 1934;16:255–68.
4. Dandy DJ. Abrasion chondroplasty. Arthroscopy 1986;2:51–3.
5. Erggelet C, Browne JE, Fu F, Mandelbaum BR, Micheli LJ, Mosely JB. Die autologe Chondrozyten-Transplantation zur Behandlung von Knorpeldefekten des Kniegelenks. Klinische Ergebnisse. Zentralbl Chir 2000;125:516–22.
6. Eysel P, Thiede S, Rumler F, Zöllner J, Rompe JD. Vergleich lasergestützter sowie konventionell mechanischer Abrasionsmethoden zur Behandlung der Chondropathie des Kniegelenks. Arthroskopie 1998;11:291–6.
7. Hangody L, Kish G, Karpati Z, Szerb I, Udvarhelyi I. Arthroscopic autogenous osteochondral mosaic-plasty for treatment of femoral condylar articular defects. Knee Surg Sports Traumatol Arthrosc 1997;3:262–7.
8. Harvin SF. Arthroscopic debridement for osteoarthritis of the knee: predictors of patient satisfaction. Arthroscopy 1999;15:142–6.
9. Hoser C, Fink C, Benedetto KP, Gabl M. Kniebewertungssysteme. Vergleich von Lysholm-Score, Marshall-Score und OAK-Knieevaluation. Arthroskopie 1996;9:196–201.
10. Lorentzon R, Alfredson H, Hildingsson C. Treatment of deep cartilage defects of the patella with periosteal transplantation. Knee Surg Sports Traumatol Arthrosc 1998;6:202–8.
11. Lübbers C, Siebert WE. Holmium:YAG-laser-assistated arthroscopy versus conventional methods for treatment of the knee. Two-year results of a prospective study. Knee Surg Sports Traumatol Arthrosc 1997;5:168–75.
12. Lysholm J, Gillquist J. Evalution of knee ligament surgery results with special emphysis on use of a scoring scale. Am J Sports Med 1982;10:150–4.
13. Magnuson PB. Joint debridement. Surgical treatment of degenerative arthritis. Surg Gynecol Obstet 1941;73:1–9.
14. Moseley JB, O'Malley K, Petersen NJ, Menke TJ, Brody BA, Kuykendall DH, Hollingsworth JC, Ashton CM, Wray NP. A controlled trial of arthroscopic surgery for osteoarthritis of the knee. N Engl J Med 2002:347:81–8.
15. Müller B, Kohn D. Indikation und Durchführung der Knorpel-Knochen-Anbohrung nach Pridie. Orthopäde 1999;28:4–10.
16. Outerbridge RE. The etiology of chondromalacia patellae. J Bone Joint Surg Am 1961;43:452–7.
17. Owens BD, Stickles BJ, Balikian P, Busconi BD. Prospective analysis of radiofrequency versus mechanical debridement of isolated patellar chondral lesions. Arthroscopy 2002;18:151–5.
18. Peterson L, Minas T, Brittberg M, Nilsson A, Sjögren-Jansson E, Lindahl A. Two- to 9-year outcome after autologous chondrocyte transplantation of the knee. Clin Orthop 2000;374:212–34.
19. Schneider T, Liebau C, Krämer R, Merk H. 10-Jahres-Analyse nach arthroskopischem Gelenkdebridement bei Gonarthrose. Arthroskopie 1999;12:17–21.
20. Schultz W, Göbel D. Articular cartilage regeneration of the knee joint after proximal tibial valgus osteotomy: a prospective study of different intra- and extra-articular operative techniques. Knee Surg Sports Traumatol Arthrosc 1997;7:29–36.
21. Shannon FJ, Devitt AT, Poynton AR, Fitzpatrick P, Walsh MG. Short-term benefit of arthroscopic washout in degenerative arthritis. Int Orthop 2001;25:242–5.
22. Steadman JR, Rodkey WG, Briggs KK, Rodrigo JJ. Die Technik der Mikrofrakturierung zur Behandlung von kompletten Knorpeldefekten im Kniegelenk. Orthopäde 1999;28:26–32.
23. Tasto JP, Ash SA. Current uses of radiofrequency in arthroscopic knee surgery. Am J Knee Surg 1999;12:186–91.

Correspondence Address
Gunter Spahn, MD
Chirurg/Unfallchirurg/D-Arzt
Praxisklinik Eisenach
Sophienstraße 16
99817 Eisenach
Germany
Phone (+49/3691) 7439-12, Fax -14
e-mail: Spahn.ESA@t-online.de