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The Arthroscopic Treatment of Unicompartmental Gonarthrosis: A Five-Year Follow-up Study of Abrasion Arthroplasty Plus Arthroscopic Debridement and Arthroscopic Debridement Alone

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Summary: A retrospective review with a mean follow-up time of 60 months was performed on 126 patients who had treatment of unicompartmental gonarthrosis with either abrasion arthroplasty plus arthroscopic debridement or arthroscopic debridement alone. Fifty-nine patients had abrasion arthroplasty and arthroscopic debridement, and 67 patients had arthroscopic debridement alone. All patients had stage II Ahlbäck changes roentgenographically, as well as Outerbridge stage IV changes arthroscopically in the involved compartment. All the knees were evaluated postoperatively at a minimum of 60 months, utilizing The Hospital For Special Surgery Knee Scoring System. In the group treated with abrasion arthroplasty, 51% had good to excellent results, 16% had fair results, and 33% had poor results. The conditions of ten of the patients who had poor results actually became worse subsequent to their abrasion arthroplasty. In the group that had arthroscopic debridement, 66% had good to excellent results, 13% had fair results, and 21% had poor results. The conditions of 12 of the patients who had poor results actually became worse subsequent to the arthroscopic debridement. **Key Words:** Abrasion arthroplasty—Arthroscopic debridement—Ahlbäck changes—Outerbridge changes—Unicompartmental gonarthrosis.

Editor's comments: This article seems to show not only that the results of surgery are unpredictable, but also that the patients who have had the surgery are unpredictable. Every orthopedic surgeon has been impressed with the fact that often there is seemingly little correlation between pain and disability and the extent of the patient's disease which, in this case, is degenerative arthritis of the knee. Figure 3c is from a woman who had a surprisingly good layer of fibrocartilage several years after abrasion arthroplasty and, despite this seemingly good result, complained of so much pain that a joint replacement was performed. This case is very similar to one reported by Pridie many years ago in which he had done multiple drill holes into the femur with a beautiful cartilaginous resurfacing. Yet, because of continued pain, the knee was fused. Logical explanations in such cases are not possible. We hope that more long-term studies such as this will appear in the literature so that we can gain a broader understanding of the effects of our surgery.

Controversy certainly exists regarding the treatment of unicompartmental gonarthrosis. Multiple procedures have been recommended with variable results. The purpose of this retrospective review is to compare abrasion arthroplasty in association with arthroscopic debridement with arthroscopic joint debridement alone in patients with unicompartmental joint space obliteration.

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MATERIALS AND METHODS

Between September 1981 and December 1982, 65 patients had abrasion arthroplasty and arthroscopic debridement for unicompartmental gonarthrosis, and 74 patients had arthroscopic debridement alone. Only patients with unicompartmental gonarthrosis in whom conservative methods of treatment had failed were selected. All of these patients originally were offered abrasion arthroplasty plus arthroscopic debridement. All of the patients who were offered abrasion arthroplasty were told they had to forgo bearing weight for 6 weeks postoperatively. Those patients who refused to do so were offered arthroscopic debridement alone. The patients who were offered arthroscopic debridement alone were allowed to bear weight when they were comfortable. All the patients in this study had complete obliteration of the compartment correlating with stage II Ahlbäck changes (1) (Table 1). X-ray films were made with the knees in full extension while the patients stood. The patients were instructed to put as much weight as possible on the involved extremity. All the knees had a minimum-size Outerbridge (2) stage IV lesion of 1.5 cm on the tibial plateau and femoral condyle (Table 2).

Fifty-nine patients who had abrasion arthroplasty plus arthroscopic debridement and 67 patients who had arthroscopic debridement alone were available for five-year follow-up review. The Hospital for Special Surgery Scoring System (HSS) (3) was utilized to grade all postoperative results.

In the group that had abrasion arthroplasty, all had <15° of varus or valgus malalignment when measured utilizing the femoral–tibial axis. These patients had to be medically capable of walking with a walker or crutches postoperatively, and each patient was asked not to bear weight on the involved extremity for 6 weeks. Surgery had previously been performed on 22% of these patients. Nine percent of these patients had previous total meniscectomies. Twenty-six percent of the 59 patients were at least 30 lb overweight and were defined as obese. The mean age in this group was 66 years, with an age range of 46–84 years. Forty-six percent were women, and 54% were men. The medial compartment was abraded in 93% of the cases and the lateral compartment in 7%. Sixty-five percent of these patients complained of night pain, which they graded as moderate to severe. Seventy-six percent of these patients had preoperative effusion. The average preoperative HSS knee score in these patients was 55 (Fig. 1). Patients with medial gonarthrosis had a minimum of 3° to 11° of varus and those with lateral gonarthrosis had a minimum of 10° and up to 14° of valgus. These measurements were obtained by utilizing the femoral–tibial axis for standing anteroposterior (AP) roentgenograms of the involved knee preoperatively.

TABLE 1. *Ahlbäck grading system*

Stage I	Joint space narrowing
Stage II	Joint space obliteration
Stage III	Minor bone attrition
Stage IV	Moderate bone attrition
Stage V	Severe bone attrition
Stage VI	Subluxation

TABLE 2. *Outerbridge grading system*

Stage I	Soft, discolored superficial fibrillation
Stage II	Fragmentation <1.3 cm^2
Stage III	Fragmentation >1.3 cm^2
Stage IV	Erosion to subchondral bone (eburnation)

In the group that had abrasion arthroplasty, the involved tibial plateau and femoral condylar lesion were abraded as reported by Johnson (4) utilizing the Dyonics abrasion instrumentation system. Only the stage IV lesions were abraded. All knees had lesions on the femoral–tibial surface of at least 15 mm when estimated arthroscopically, utilizing a graduated nerve hook as a reference point. Eight knees had lesions measuring at least 2½–3 cm in diameter. Subchondral intracortical bone was abraded to a depth of approximately 1–2 mm until bleeding bone was noted. Any additional joint debridement along with arthroscopic partial meniscectomy was performed at the time of the abrasion arthroplasty. Loose bodies were removed as well as any other joint debris. Removal of osteophytes was not performed unless they were loose or resulted in significant impingement on surrounding soft tissues. Postoperatively, the patients were instructed not to bear weight for 6 weeks. The majority of patients admitted to touch-down weight bearing after 3½–4 weeks.

In the group that had arthroscopic debridement, patients with medial compartment disease had a minimum of 3° and up to 10° of varus. The two patients with lateral compartment disease had 10° and 12° of valgus, respectively. These measurements were obtained from standing AP roentgenograms of the involved knee in full extension utilizing the femoral–tibial axis. All of these patients had complete obliteration of the joint space. These patients were allowed to weight bear when their knees felt comfortable, but otherwise were asked to walk

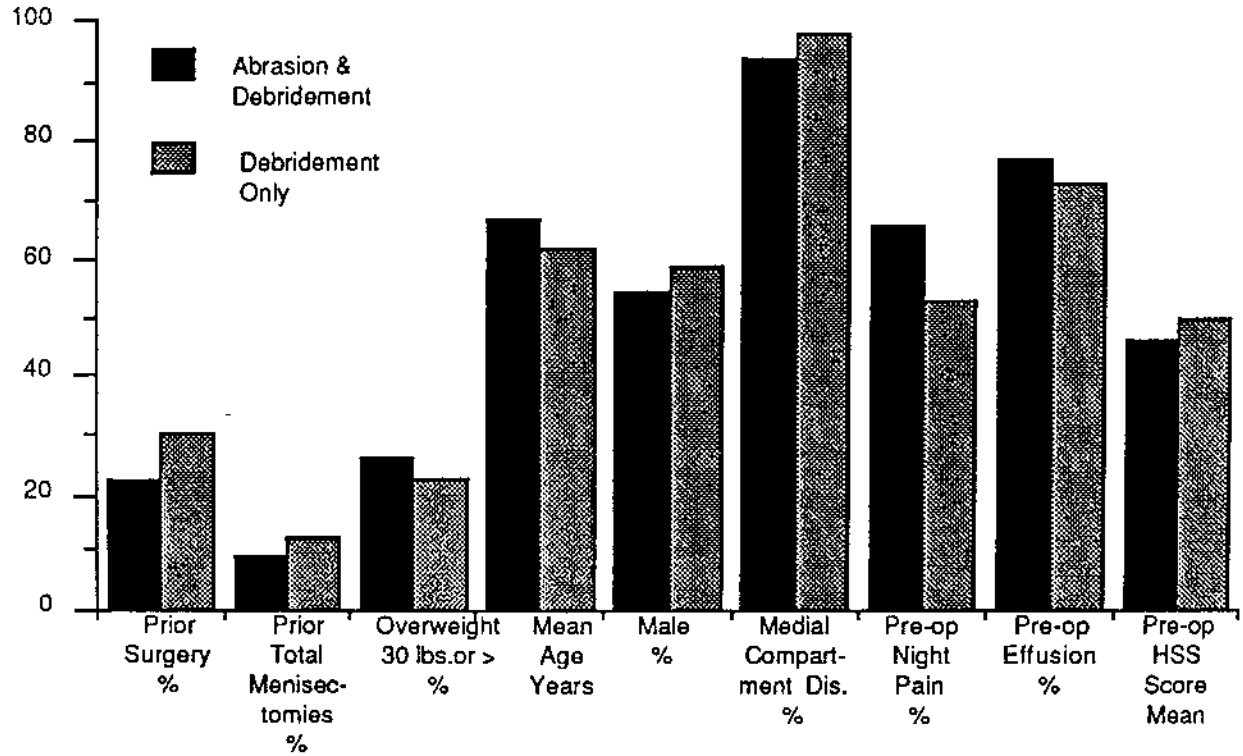

FIG. 1. Average preoperative scores for knees that underwent either abrasion arthroplasty plus arthroscopic debridement or debridement alone, according to The Hospital for Special Surgery Scoring System (HSS). Dis. is disease.

with a walker or crutches until able to tolerate full weight bearing. Thirty percent of these patients had prior surgery. Twelve percent had prior total meniscectomies. Twenty-two percent were at least 30 lb overweight. The mean age in this group was 61 years, with an age range of 39–82 years. Fifty-eight percent were men. The medial compartment was involved in 97% of the patients and the lateral compartment in 3%. Fifty-two percent had night pain that they graded as moderate to severe. Seventy-two percent had preoperative effusion. The mean preoperative knee score in these patients was 49.

In the group that had arthroscopic debridement, partial medial meniscectomy was performed utiliz-

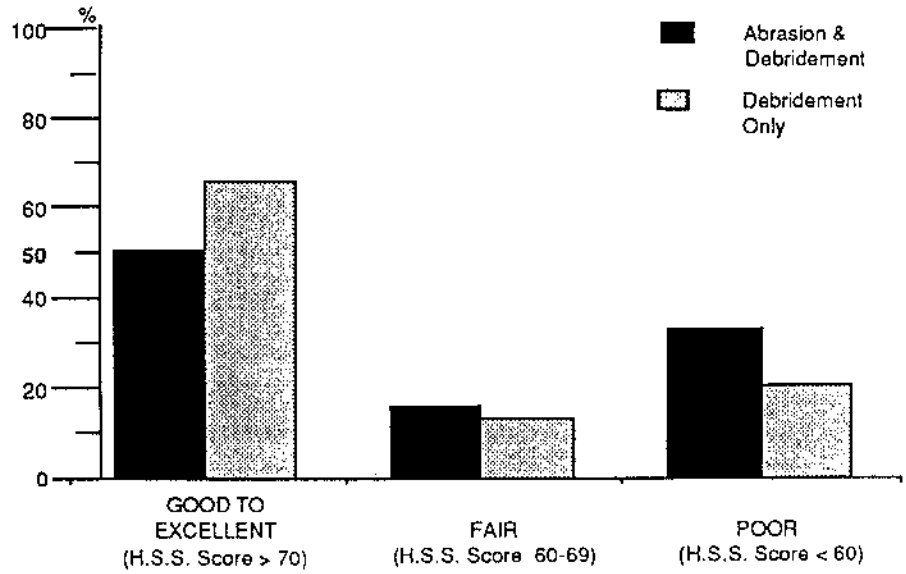

FIG. 2. The Hospital for Special Surgery Scoring System (HSS) postoperative scores for knees that underwent either abrasion arthroplasty plus arthroscopic debridement or debridement alone.

ing motorized as well as manual and electrocautery instrumentation, trimming the degenerative meniscus back to a stable rim. If the rim was considered unstable, a subtotal resection of the meniscus then was performed in a routine fashion. Debridement of the articular surface surrounding the stage IV lesions was performed utilizing a synovial resector. Loose bodies were removed, as well as any other joint debris, utilizing manual and motorized instrumentation. Removal of osteophytes was not performed unless they were loose or grossly impinging on surrounding soft tissue. A partial synovectomy was performed as necessary. These patients were allowed to bear weight as tolerated postoperatively.

In both groups, patients' conditions were evaluated at 3 months, 6 months, and yearly intervals thereafter.

RESULTS

Fifty-nine of the patients who had abrasion arthroplasty and arthroscopic debridement were available for 5-year follow-up review. The HSS system was utilized to grade all postoperative results. Knees with a rating of 85 or more were graded as excellent. Knees with ratings of 70–84 were considered to have a good result. Scores between 60–69 were graded as fair, and scores of <60 were considered poor (Fig. 2).

At 5 years, 51% of the patients who had abrasion arthroplasty had good to excellent results, 16% had fair results, and 33% had poor results. The conditions of 10 patients with poor results actually became worse subsequent to their abrasion arthroplasty. Of the 29 patients who had fair or poor results subsequent to abrasion arthroplasty, 15 have been converted to total knee replacement. Twelve of these 15 were converted to total knee replacement within 1 year after abrasion arthroplasty because of unsatisfactory results from the procedure. All of the patients with good or excellent results stated that they would make the same decision, i.e., to have the operation, again, and none wanted further surgery.

Fifty-one percent of the patients who had abrasion arthroplasty showed joint space widening correlative with stage II Ahlbäck changes roentgenographically at the 2-year follow-up examination on

3A–C

FIG. 3. A: The knee of a 58-year-old woman with medial compartment joint space obliteration (Ahlbäck stage II). B: Standing anteroposterior view taken 18 months after abrasion of the medial compartment. Joint space widening is evident (Ahlbäck stage I). C: This patient's knee at the time of unicompartmental replacement surgery 18 months after abrasion shows abundant proliferation of regenerated fibrocartilage covering the previously abraded femoral condyle and tibial plateau.

4A–C

standing full-extension AP roentgenograms of the knee. However, 31% of knees with joint space widening had no improvement in symptoms or actually became worse. Radiologic evidence of joint space widening, therefore, did not necessarily indicate a good result. In 20% of the patients who had satisfactory results, standing x-ray films demonstrated persistence of joint space collapse. Figure 3A–C illustrates the case of a 58-year-old woman with medial compartment joint space obliteration. The patient's pain increased despite joint space widening subsequent to abrasion arthroplasty, and unicompartmental total knee arthroplasty was performed.

Figure 4A–C summarizes the experience of a 69-year-old woman with medial joint space obliteration. This patient had abrasion arthroplasty with subsequent joint space widening 2 years postoperatively. Note the breakdown of the reparative fibrocartilage in the medial compartment evident at surgery 3 years after abrasion arthroplasty. Histologic evaluation of the regenerative fibrocartilage at 3 years in this patient revealed reparative fibrocartilaginous tissue on the surface with a weakly stainable fibrous-appearing matrix. Note the normal staining pattern of the cartilaginous matrix (Fig. 5A–D).

Figure 6 is a standing AP view of a patient's knee 5½-years after abrasion arthroplasty of the lateral compartment. This patient now has 18° of valgus when measuring the femoral–tibial axis on her standing AP view of the knee and yet has a knee score of 94, indicating an excellent result. There appears to be no correlation between the extent of residual varus or valgus subsequent to abrasion arthroplasty and postoperative HSS scores. Several patients with significant residual deformity with or without joint space collapse had excellent results, as illustrated in this patient, whereas some patients with significant deformity had poor results with or without joint space collapse. Furthermore, several patients with minimal residual deformity and joint space widening had poor results, whereas some patients with persistence of joint space collapse and increased deformity postoperatively had good to excellent results.

Sixty-seven of the 74 patients who had arthroscopic debridement alone were available for 5-year

4A–C

FIG. 4. A: The knee of a 69-year-old woman with significant medial compartment joint space obliteration (Ahlbäck stage II). B: Joint space widening is evident at 2 years postoperatively on this standing anteroposterior roentgenogram (Ahlbäck stage I). C: At the time of unicompartment replacement surgery 3 years after the original abrasion, breakdown of the reparative fibrocartilage in the medial compartment is evident.

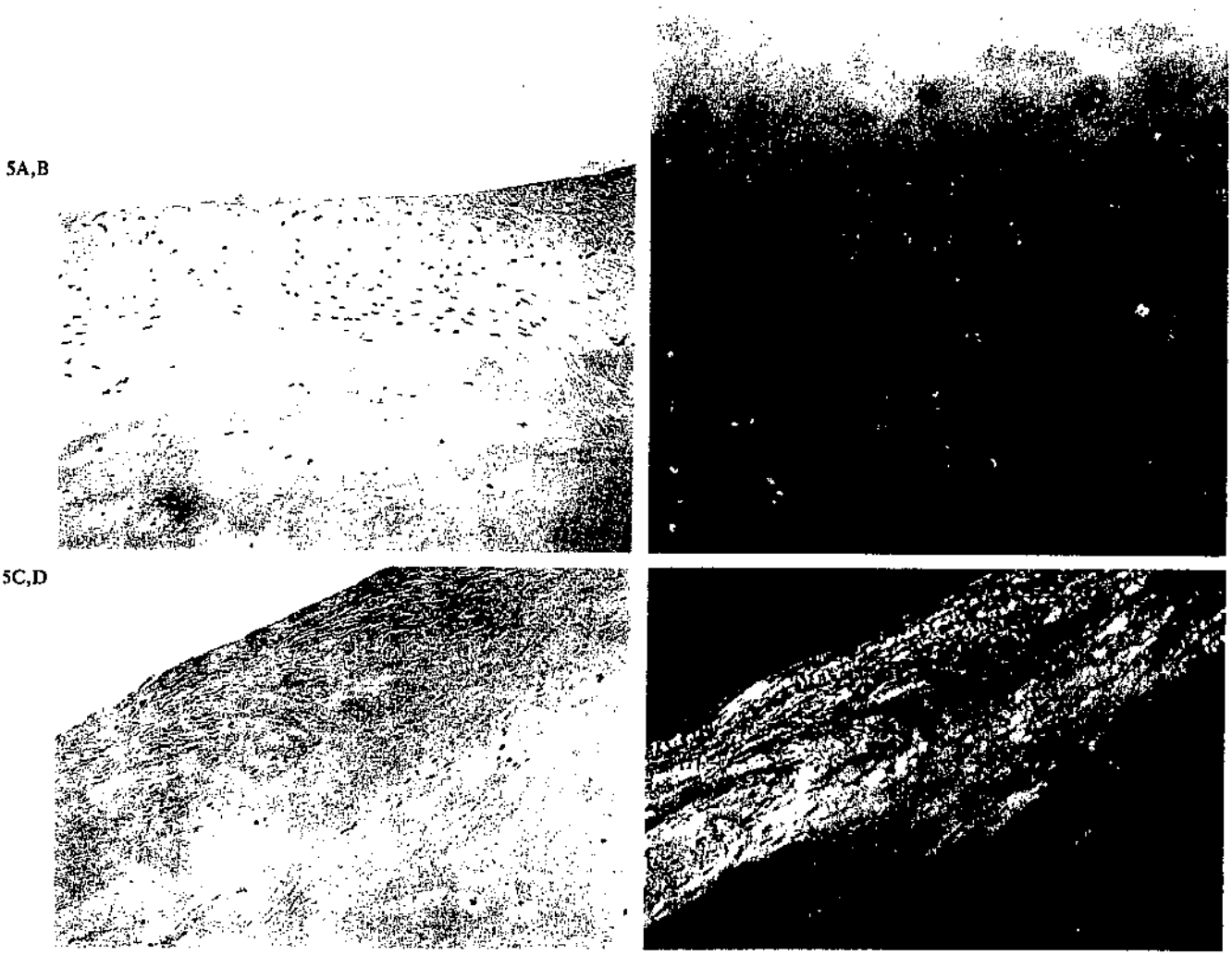

FIG. 5. The same patient as described in Fig. 3. A: At 1½ years after the original abrasion, a reparative fibrocartilaginous tissue appears on the surface with a stainable fibrous-appearing matrix. Note the fibrocartilaginous surface with underlying, more normal-appearing hyaline cartilage. B: Staining with safranin-O identifies the presence of proteoglycan. The fibrous surface of the joint does not stain, indicating a lack of proteoglycan. C: Cross-section of cartilage surface stained with hematoxylin–eosin shows the surface fibrocartilage. D: Polarized light view of the same section shows the orientation of the surface collagen in the fibrocartilage. This orientation is abnormal and is quite different from that of normal hyaline cartilage.

follow-up review. Sixty-six percent of these patients had good to excellent results, 13% had fair results, and 21% had poor results. Twelve of the knees with poor results actually became worse subsequent to the arthroscopic debridement, and 10 of these 12 patients have had subsequent total knee arthroplasty. None of these patients had joint space widening at 2-year follow-up examination according

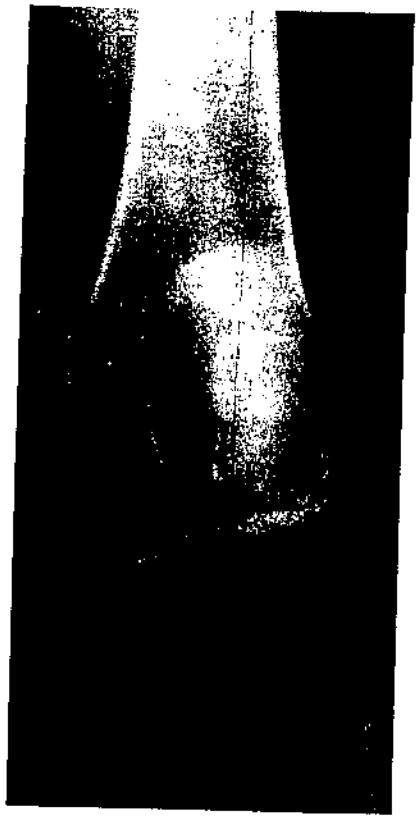

FIG. 6. Standing anteroposterior view taken 66 months after abrasion of lateral compartment. Joint space widening is evident (Ahlbäck stage I). Eighteen degrees of valgus is present measuring the femoral–tibial axis. The patient has a knee score of 94, which is considered an excellent result.

to standing full-extension AP roentgenograms of the knee.

DISCUSSION

The surgical options for unicompartmental gonarthrosis are upper tibial osteotomy, joint debridement, upper tibial osteotomy and joint debridement, unicompartmental knee replacement, total knee replacement, abrasion arthroplasty, upper tibial osteotomy and abrasion arthroplasty, cortical drilling, and cortical drilling in conjunction with upper tibial osteotomy. The success rates with these surgical procedures vary greatly and are to some degree dependent on length of follow-up observation.

Upper tibial osteotomy has a reported success rate of 62.5% at 9 years and 61.8% at 10 years and beyond (5). Recent studies have correlated successful results with the degree of correction. Success rates as high as 91% have been reported if the valgus angle is maintained at 6° or greater (6).

Broughton et al. (7) reported a 5-year review of groups that had either upper tibial osteotomy or unicompartmental replacement. Seventy-six percent of the patients in the group that had unicompartmental replacement and 43% in the group that had osteotomy had satisfactory results (7). The complication rate with upper tibial osteotomy, however, is significant. The collective reported complication rate prior to 1985 of 1,200 upper tibial osteotomies is 21%. Complications include peroneal palsy, vascular insufficiency, pulmonary embolus, infection, and fragment fracture (8,9).

Upper tibial osteotomy plus debridement was originally reported in 1977 by McIntosh and Welsh (10). They performed an open joint debridement in conjunction with the osteotomy that resulted in 82% satisfactory results with a follow-up observation of 1–13 years. The complication rate, however, was 15%.

Unicompartmental replacement was reported in seven different series between 1974 and 1988 with follow-up time of 1–9 years. The success rates were 37–96%, and the complications reported were between 7–36% (11–17).

The concept of drilling through eburnated bone to stimulate cartilage formation was originally described by Pridie in 1959 (18). He described fibrous-like reparative cartilage filling and covering these ¼-inch cortical drill holes. He reported that 65% of his patients had satisfactory results (18–20).

Arthroscopic debridement as a treatment option for unicompartmental gonarthrosis was reported by Sprague in 1981 (21). He reported 84% satisfactory results at a mean follow-up time of 13.6 months. Shahriaree et al. (22) in 1982 reported 72% successful results at 5–7 years of follow-up review. More recently, Jackson et al. (23) reported 68% improvement at a mean of 3.3 years with 2–11 years follow-up study. They reported simple arthroscopic debridement of condylar and meniscal tissue in patients with degenerative changes in their joints. In these three studies, however, the degree of degenerative changes within the joint was not correlated roentgenographically or arthroscopically with the results.

The early results of abrasion arthroplasty were reported by Friedman et al. in 1984 (24). They reported one-year follow-up studies that showed 60% of knees with fair to good results and 6% that became worse. Chandler in 1984 reported 80% satisfactory results after 1.8 years in 55 knees (25). However, 16% of these knees became worse after the procedure.

Abrasion arthroplasty is an arthroscopic technique used to remove eburnated bone by exposing intracortical vessels on the tibial and femoral surfaces of the knee. The organizing hematoma forms over this abraded surface and then differentiates into fibrocartilage through clot stabilization. However, because adult articular cartilage does not heal and the regenerative tissue is not hyaline cartilage but fibrocartilage, which lacks normal amounts of proteoglycan, the regenerative fibrocartilage theoretically should have a difficult time transferring compressive loads and cannot be expected to survive in an abnormal mechanical environment. In this series of patients, the results of abrasion arthroplasty worsened with time, presumably as a result of the deterioration of the load-bearing capability of the regenerative fibrocartilage. Whether this regeneration of fibrocartilage is necessary for the patient to obtain a good result after abrasion arthroplasty is unknown. In this series, 20% of the patients who continued to have joint space collapse had satisfactory results. Coventry and Bowman noted that formation of hyaline-like cartilage occurred in the unloaded medial compartment of several patients after valgus upper tibial osteotomies (26). This finding was confirmed by Fujisawa arthroscopically 12–18 months following upper tibial osteotomies, which implies that regeneration of hyaline-like reparative cartilage can occur secondary to unloading of bone without additional surgery (27).

CONCLUSION

In this series of patients, the results of abrasion arthroplasty plus arthroscopic debridement were totally unpredictable. These results were unrelated to age, presence of previous surgery, weight, extent of unicompartmental disease, the presence or absence of joint space widening following surgery, and the extent of residual varus or valgus deformity.

Based on the 5-year follow-up results in this series, arthroscopic debridement alone resulted in a higher success rate than abrasion arthroplasty associated with arthroscopic debridement in patients with unicompartmental gonarthrosis with complete obliteration of the joint space.

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