

Knee health promotion option for knee osteoarthritis: A preliminary report of a concept of multidisciplinary management

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Abstract

Background: Osteoarthritis (OA) of the knee is a main cause of disability in the elderly population. Although there are a number of treatments that can help ease symptoms, there is, as yet, no cure. The objective of this study was to evaluate the preliminary outcome of a multidisciplinary management option based on studies of medial abrasion syndrome (MAS) as a cause of knee OA.

Methods: Over a period of one year 520 patients were enrolled into this study, between them having 862 knees at different stages of OA. There were 127 males (24.4%) and 393 females (75.6%). The mean age of these patients was 65 years (SD: 10). An integrated protocol for the treatment of knee OA, based on the findings of research into MAS, which we call the “knee health promotion option (KHPO)”, was implemented for these patients. For this preliminary report, subjective satisfaction was assessed after follow-up at one year.

Results: After one year, 511 patients with 844 affected knees (97.9%) remained enrolled in the study. The mean age of these patients at the time of surgery was 64 years (SD: 10). Subjective assessment was satisfactory in 794 (94.1%) knees. Six-hundred-and-fifty-seven knees (77.8%) of 379 patients received an arthroscopic cartilage regeneration facilitating procedure (ACRFP), 71 knees (8.4%) of 70 patients received unicompartmental arthroplasty (UKA), and 116 knees (13.8%) of 116 patients received total knee arthroplasty (TKA). For the arthroplasty group, the subjective assessment was satisfactory in 187 knees (100%). For the ACRFP group, the subjective assessment was satisfactory in 607 knees (92.4%). In the ACRFP group, the satisfactory rate was 91.2% for 228 stage II knees, 93.6% for 327 stage III knees, and 91.2% for 102 stage IV knees. Three knees in the stage IV group had converted to arthroplasty after the minimum follow-up of one year.

Conclusions: According to this preliminary report, KHPO targeting on the MAS as a cause of knee OA could provide patients with a high degree of treatment satisfaction. Further studies are mandatory to investigate their long-term outcomes.

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Introduction

Osteoarthritis (OA) of the knee is a major cause of chronic musculoskeletal pain and is ranked as a main cause of disability in the elderly population. It is a disease of uncertain multifactorial etiology, which eventually affects the entire joint. Various etiologic risk factors have been proposed, but the exact

pathogenesis is still unknown. Although there are a number of treatments that can help ease symptoms and reduce the chances of disease progression, there is, as yet, no cure [1-3].

In 2006, we reported that in patients with medial compartment osteoarthritic knees, the prevalence of medial plica was significantly higher than in other

patients without medial compartment osteoarthritis. Furthermore, we found two distinct foci of cartilaginous lesions on the facing medial femoral condyle in almost all of the patients with medial plica [4]. Our further studies not only disclosed the kinematic relationship between the medial plica with the medial femoral condyle during knee motion in vivo [5], but also implied the close interplay between this structure and the medial femoral condyle [6]. More recently we have found [7, 8] that the repeated injuries elicited by this abrasion phenomenon might trigger interleukin-1 β (IL-1 β) production in medial plica, thus enhancing the expression of matrix metalloproteinase-3 (MMP-3). Based on these findings, a concept of arthroscopic medial release (AMR) for the treatment of OA of the medial compartment of the knee joint was developed [9]. The clinical outcome of this procedure led us to believe that, by eradication of the abrasion phenomenon between the tight, fibrotic and hypertrophied medial structure and the adjacent medial femoral condyle, most patients' pain could be reduced, and the degenerative process in the medial compartment of some patients might be decelerated or arrested.

We therefore proposed the concept of an arthroscopic cartilage regeneration facilitating procedure (ACRFP), which combines AMR with conventional arthroscopic procedures including synovectomy, chondroplasty, partial meniscectomy and percutaneous lateral release as a rationale for the deliberate arthroscopic management of OA knees. We found that eliminating existing detrimental factors will provide a preferable environment for the regeneration of damaged cartilage [10]. In 2009, we developed a multidisciplinary treatment option, which we called the "knee health promotion option (KHPO)" [11], for global management for knee OA. This option is based on the above-mentioned studies of MAS as a cause of knee OA.

In this study, we present the details of this treatment option and its preliminary outcomes. We postulate that this multidisciplinary approach would be beneficial for patients with different stages of knee OA.

Methods

Patients

During 2011, 862 knees of 520 patients with different stages of knee OA were enrolled into the KHPO protocol. There were 127 males (24.4%) and 393 females (75.6%). Age ranged from 17 to 86, with a mean age of 65 years (SD: 10). Inclusion criteria were: patients with an OA knee at any stage of severity, and conservative treatment including non-steroidal anti-inflammatory drugs (NSAIDs), nutrition supplements (glucosamine sulfate and/or hyaluronic acid injection) and physiotherapy for more than six months without improvement. Exclusion criteria were: knees with instability due to previous ligament injury, major meniscus tear, or OA due to trauma.

This study was approved by the Research Ethics Committee of Buddhist Dalin Tzu-Chi General Hospital, which has been certificated by the Department of Health, Taiwan (IRB Approval Number: B09704022). A signed consent form was received from all patients, indicating their informed consent to participate in the study.

Knee health promotion option

An integrated protocol shown in Fig. 1, which we call the "knee health promotion option (KHPO)", was implemented for the treatment of OA knees based on the findings of our previous research [4-8] regarding MAS as a cause of knee OA and the clinical outcome of ACRFP [10].

The details of this protocol are presented as follows.

Clinical staging

The first step in the KHPO protocol was to establish the clinical stage for each compartment of the knee by rentgenographic examination including standing anteroposterior, lateral, and Merchant's views. The degree of joint space narrowing, presentation of osteophytes, and alignment measured by femorotibial angle were the main parameters evaluated, as shown in Table 1. The final stage of OA of the whole knee was given as the most advanced stage of the three compartments.

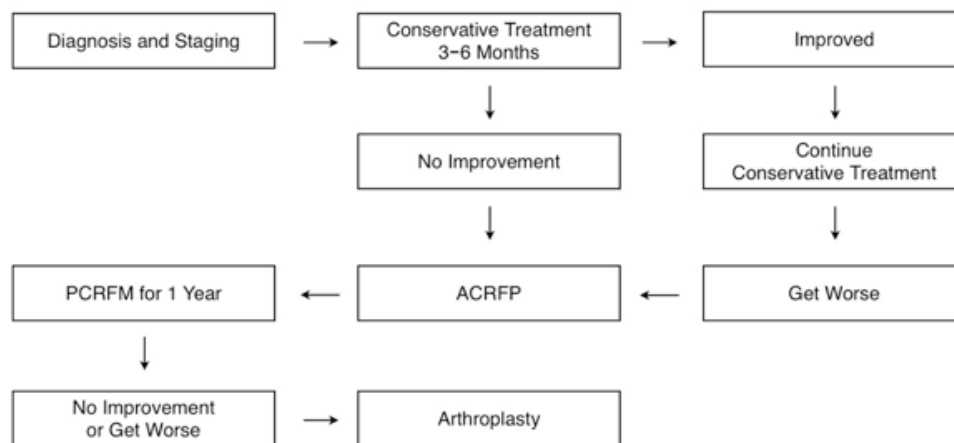


Figure 1. Knee Health Promotion Option (KHPO) protocol. The key determinant for success is to obtain complete consensus from the patient about this novel concept before enrolling him/her into the protocol. In our practice, patients will be under strict surveillance by their case manager and a nursing specialist during the process.

ACRFP: arthroscopic cartilage regeneration facilitating procedure

PCRPM: post-operative cartilage regeneration facilitating modalities

Table 1. Clinical staging for OA of individual compartment based on clinical, rentgenographic and possible correlated arthroscopic findings

Stage	Rentgenographic Findings		Clinical Findings		Arthroscopic Findings
	Joint space narrowing	Osteophyte	Deformity	Stability	
I	Doubtful	No	Normal	Stable	Smooth surface, loss of normal elasticity
II	Definite, no more than 1/2	Doubtful	< 5°	Stable	Uneven surface, superficial to moderate cartilage damage (bubbling, fibrillation)
III	Marked, more than 1/2	Definite	5~10°	Stable	Deep cartilage damage (chondral flap, subchondral bone exposed < ½ area)
IV	Complete obliterated	Marked	> 10°	Stable	Full thickness cartilage damage (subchondral bone exposed > ½ area)
V	Complete obliterated	Marked	> 10°	Unstable	Full thickness cartilage damage (subchondral bone exposed > ½ area)

Treatment option decision-making

Once the clinical stage of the knee had been determined, a treatment option for individual knees was decided according to the guideline listed in Table 2. For stage II-III patients, ACRFP was the best choice. For stage IV patients, although arthroplasty was usually recommended, ACRFP was still valued depending on patients' biopsychosocial condition and preferences. Unicompartamental knee arthroplasty (UKA) was the first choice for stage IV or V OA involving only one compartment. For stage IV or V OA involving more than one compartment, total knee arthroplasty (TKA) was recommended.

Using this guideline to determine treatment options, 675 knees (78.3%) of 388 patients received ACRFP, 71 knees (8.2%) of 70 patients received UKA (33 of them received ACRFP for the other knee simultaneously), and 116 knees (13.4%) of 116 patients received TKA (21 of them received ACRFP for the other knee simultaneously).

Table 2. Recommendation of treatment option for different stage of OA knee

Stage	ACRFP	UKA	TKA
I	-	-	-
II	++	-	-
III	+++	-	-
IV	++	+++	++
V	-	++	+++

Conservative treatment before surgery

All except stage V patients were recommended to undergo supervised conservative treatment for at least three months before a final decision was made as to whether or not to receive surgery. The sine qua non for successful conservative treatment was to ensure that patients and their families completely understood the concept of KHPO. The phenomenon of medial abrasion as an important etiologic factor was emphasized. Daily activities, job and exercise modifications were tailored for individual patients, focusing on avoidance of the medial abrasion

phenomenon. In general, activities and exercises necessitating repeated bending of the knee were regarded as harmful. Table 3 shows example recommendations for activities and exercises according to this principle. Patients were instructed to perform home-based rehabilitation exercises including muscle strengthening and soft tissue stretching around the knee; adherence to this exercise program was followed up under close surveillance by case managers and nursing specialists.

Table 3. Recommendation for suitable or harmful activities and exercises for OA knee

Suitable	Harmful
Walking	Stairs or mountains climbing
Jogging	Squatting (e.g. gardening)
Golf	Bicycling
Swimming using freestyle or butterfly stroke	Swimming using breaststroke

Post-operative cartilage regeneration facilitating modalities after ACRFP

The purpose of post-operative care after ACRFP was to unveil and facilitate the degenerated cartilage's natural ability to repair itself. During the first three months after ACRFP, the aim of rehabilitation was to prevent scar contracture and consequent recurrence of the medial abrasion phenomenon. Gentle exercise involving deep bending and stretching was encouraged after each session of quadriceps strengthening exercise. To facilitate cartilage regeneration, patients were instructed to follow strict rules regarding appropriate daily activities and exercises (listed in Table 3) during the first post-operative year. The rationale for this precaution was to avoid repeated bending of the knee that might produce a shearing force counterproductive to cartilage regeneration.

Follow-ups and evaluation of clinical outcome

Patients were evaluated monthly for three months. Thereafter, they came back yearly for an outcome assessment. The comparisons of both pre- and post-operative Knee Society score (KSS) and knee injury

and osteoarthritis outcome score (KOOS) were used for outcome evaluation. Subjective satisfaction was assessed by direct questioning using a categorical scale prepared for this study: excellent, free of symptoms, no limitation in activities; good, greatly improved, occasional pain, normal activities; fair, same as pre-operative condition, no improvement; and poor, has received or considered further operative treatment. The outcome was regarded as satisfactory if subjective satisfaction was rated as “excellent” or “good”. The inquiry into subjective satisfaction and the evaluation of KSS and KOOS were conducted by nursing specialists. All investigations focused on individual knees in bilateral cases. For this preliminary report, only subjective satisfaction was analyzed.

Statistical analysis

All values were presented with means and standard deviations. Comparisons were made using a paired t-test to detect differences in the distribution of patient age and satisfaction rating at each stage of osteoarthritis and each surgical modality. All statistical analysis was carried out using JMP, the Statistical Discovery Software (Version 5.0.1.2, SAS Institute Inc., Cary, NC, USA).

Results

At follow-up after more than one year, 844 knees of 511 patients were still available for study; the mean follow-up period was 14 months (SD: 2). Patients lost before follow-up included: four of 233 (1.7%) grade II osteoarthritic knees in three patients; seven of 350 (2%) grade III osteoarthritic knees in five patients, and five of 260 (1.9%) knees with grade IV osteoarthritis in four patients. All nine of these patients received bilateral ACRFP.

The total follow-up rate was 97.9%. Seven-hundred-and-ninety-eight knees of 482 patients returned and completed thorough outcome study questionnaires including subjective outcome evaluation, X-ray examination, KSS and KOOS evaluation. Another 29 patients (46 knees) completed the subjective outcome evaluation by telephone. The mean age of these patients at the time of surgery was 64 years (SD 10).

The mean age and distribution of different OA grades, stratified by the procedure patients received, are shown in Table 4. Six-hundred-and-fifty-seven knees (77.8%) of 379 patients received ACRFP, 71 knees (8.4%) of 70 patients received UKA, and 116 knees (13.8%) of 116 patients received TKA. Patients' mean age was positively correlated by ANOVA with the severity of OA and the type of surgery.

Table 4. Age and sex distribution of different grade of OA stratified by type of surgery

	ACRFP	Uni-K	TKA	Total
Grade	Age (SD) / No.	Age (SD) / No.	Age (SD) / No.	Age (SD) / No.
II	* 56 (11) / 228	-	-	* 56 (11) / 228
III	* 65 (9) / 327	-	-	* 65 (9) / 327
IV	* 66 (9) / 102	69 (7) / 69	71 (6) / 99	* 68 (8) / 270
V	-	70 (11) / 2	72 (5) / 17	* 72 (5) / 19
Total	*62 (11) / 657	*69 (7) / 71	*71 (6) / 116	64 (10) / 844
	p<0.0001, R ² =0.17	p=0.86, R ² =0.0004	p<0.36, R ² =0.007	p<0.0001, R ² =0.23

* Statistically significant by comparisons for each pair using paired t test (p<0.0001)

For this preliminary report, we analyzed only the subjective satisfaction rates. As shown in Table 5, the subjective assessment was deemed to be satisfactory in 794 (94.1%) of the 844 knees available for final review. For the ACRFP group, subjective assessment was satisfactory in 607 knees (92.4%). In the ACRFP group, the satisfaction rate was 91.2% for 228 stage II knees, 93.6% for 327 stage III knees, and 91.2% for 102 stage IV knees. Three knees in the stage IV group converted to arthroplasty after the minimum follow-up of one year. For the arthroplasty group, the subjective assessment was satisfactory in 187 knees (100%).

Table 5. Subjective Outcomes of different stage of OA stratified by type of surgery

Stage	ACRFP (N=657)					Uni-K (N=71) TKA (N=116)					Total Sat. (%)
	E†	G	F	P	Sat. (%)	E	G	F	P	Sat. (%)	
II	97 (42.5)	111 (48.7)	20 (8.8)	-	91.2	-	-	-	-	-	228 (91.2)
III	132 (40.4)	174 (53.2)	19 (5.8)	2 (0.6)	93.6	-	-	-	-	-	327 (93.6)
IV	44 (43.1)	49 (48.1)	6 (5.9)	3 (2.9)	91.2	59 (85.5)	10 (14.5)	-	-	100	270 (96.7*)
						76 (76.8)	23 (23.2)	-	-	100	
V	-	-	-	-	-	2 (100)	-	-	-	100	19 (100*)
						14 (82.4)	3 (17.6)	-	-	100	
Total	273 (41.6)	334 (50.8)	45 (6.8)	5 (0.8)	92.4	61 (85.9)	10 (14.1)	-	-	100*	844 (94.1)
						90 (77.6)	26 (22.4)	-	-	100*	

† E: excellent; G: good; F: fair; P: poor; Sat.: satisfied = E + G

* Statistically significant by comparisons for each pair using paired t test (p<0.05)

Discussion

In this preliminary report we present the details and clinical outcomes of a multidisciplinary management protocol, which we call the “knee health promotion option” (KHPO) for OA knee patients requiring surgical treatment. This global management concept was based on our understanding of the medial abrasion phenomenon as a cause of knee OA [4-8]. At follow-up after more than one year, patient satisfaction rate was 100% for patients who received arthroplasty, including 71 (8.4%) UKA and 116 (13.8%) TKA. For the 657 knees (77.8%) received ACRFP, the satisfactory rate was 92.4%. Overall, the subjective satisfaction rate of these 844 knees was 94.1%.

OA is the most common form of knee arthritis and a major contributor to functional impairment and reduced independence in older adults. Since the pathogenesis and etiologic factors remain undefined, more than 50 modalities of non-pharmacological,

pharmacological and surgical therapy for knee OA are developed and described in the medical literature [1]. In recent years, both the Osteoarthritis Research Society International (OARSI) and the European League against Rheumatism (EULAR) have developed recommendations to optimize the treatment of knee OA based on a variable combination of expert consensus and systematic review of research evidence. According to these guidelines, a multidisciplinary approach including education and self-management was recommended as appropriate and effective [1-3, 12].

Comparing to the subjective satisfaction rate of 85.5% in our previous study, which followed up 505 knees after three years, which had received ACRFP without a multidisciplinary approach[10], the high satisfaction rate (92.4%) found in this preliminary report is promising. Patients’ satisfaction after knee arthroplasty is variable. High percentages of dissatisfaction considering patients’ concerns were reported in both UKA [13] and TKA [14, 15]. A

comparison study between subjective and objective outcome systems revealed poor correlations, suggesting that the concerns and priorities of patients and surgeons differ [16]. The 100% satisfaction rate found in our arthroplasty group further demonstrates the value of the multidisciplinary approach for knee OA.

Although there seems to be a consensus regarding the value of education and self-management for knee OA [17-19], there are still discrepancies between patients' and practitioners' views of knee OA and its management. According to a recent qualitative study [20], providing adapted and formalized information to patients, adopting greater global assessment and more therapeutic approaches, and dealing more accurately with patients' paradoxical representations of therapy are key ways to improve the patient-physician relationship and the efficacy of treatment strategies. Based on our research and understanding about the medial abrasion phenomenon as a cause of pain and disability in most knee OA patients [4-8], our formalized global management protocol could provide precise and adequate information for both patients and health care providers.

In addition, in comparison with the uncertain beneficial mechanism and the diversity of outcomes of current popular arthroscopic techniques including lavage, debridement, abrasional chondroplasty and microfracture for osteoarthritis of the knee, the concept of ACRFP has a more precise rationale of treatment. Our study [7] found that the repeated injuries elicited by this abrasion phenomenon might trigger IL-1 β production, thus enhancing the expression of MMP-3. Our demonstration of the expression of IL1- β mRNA, MMP-3 mRNA and MMP-3 in medial plica of early stage OA knee suggests that this structure and its interplay with the facing medial femoral condyle might play an important role in the pathogenesis of medial compartment OA knee. These findings coincide with the fact that eradication of this structure by arthroscopic release could be effective in symptom relief, or might even modify disease progression in the medial compartment of OA knees [9, 10].

In conclusion, a multidisciplinary management protocol (KHPO) for knee OA, based on the concept of treating the medial abrasion phenomenon, could

provide promising outcomes in the majority of patients in the short term. Continuous long-term follow-up and more precise outcome studies are mandatory.

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