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ORIGINAL ARTICLE

Long-term deterioration after one-stage unicompartmental knee arthroplasty and anterior cruciate ligament reconstruction

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Abstract

Purpose Treatment for unicompartmental knee osteoarthritis (OA) is controversial in young patients with concomitant anterior cruciate ligament (ACL) deficiency. The aim of the current study is to report long-term results after the combination of unicompartmental knee arthroplasty (UKA) and ACL reconstruction.

Methods Retrospective study of one-stage medial UKA and ACL reconstruction was performed on eight patients at a mean age of 52 years (42–60). Clinical and radiological results were assessed and analyzed after a mean follow-up of 14.6 years.

Results Patients were satisfied and mean personal satisfaction rate was 8.8 (4–10). At the last follow-up, mean WOMAC score was 26 (1–52) and mean global KSS was 154 (102–200). One revision surgery to total knee arthroplasty was performed 9 years after the combined procedure due to aseptic loosening. One more case of clinical deterioration was observed 13 years after index surgery.

Conclusions Combined UKA and ACL reconstruction can be a therapeutic option for young and active patients with concomitant knee instability and unicompartmental OA. The procedure is highly demanding and reliable only in hands of experienced surgeons. Overall, satisfactory outcome can be achieved at a minimum follow-up of 10 years. However, clinical deterioration can be observed in the long term.

Keywords UKA · ACL reconstruction · One stage · Long term

Introduction

Patients with unicompartmental knee osteoarthritis (OA) and concomitant anterior cruciate ligament (ACL) deficiency have traditionally been treated by total knee arthroplasty (TKA). Nevertheless, TKA is not the optimal procedure in young and active patients, whose quality of life can be strongly related to the condition of the knee. Therefore, a less invasive alternative would be preferable in prevention of need for future revision surgery.

Unicompartmental knee arthroplasty (UKA) could be an appropriate alternative for the treatment of these patients. However, ACL deficiency was associated with increased failure rates and consequently, it was proposed as a relative contraindication for UKA [1, 2]. On the other hand, subsequent clinical studies with big sample sizes and long follow-up periods could not find any statistically significant difference between deficient and intact ACL knees, after UKA was performed [3, 4]. Differences in prosthetic designs or demographic data between studies could explain these disparate conclusions. The result is the existing controversy for the treatment of patients with concomitant ACL deficiency and unicompartmental OA.

A combined ACL reconstruction and UKA was proposed as a solution to this dilemma [5–8]. Indeed, ACL reconstruction can restore kinematics in the UKA knee to magnitudes similar to those in the ACL-intact knee [9]. Although satisfactory early outcomes were reported, the continuity of good results after a longer follow-up period remains unknown. The objective of the present study is to evaluate outcomes of combined UKA and ACL reconstruction in the long term, as a treatment for unicompartmental knee OA and concomitant ACL deficiency.

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Materials and methods

Between January 1994 and February 2004, 10 patients with primary ACL deficiency and concomitant symptomatic unicompartmental knee OA were treated with UKA and ACL reconstruction. All patients had secondary OA due to previous ACL injury. They reported knee instability and pain at the medial joint line in all cases. Exclusion criteria were ACL tear secondary to knee OA, ACL tear without instability symptoms, varus deformity of more than 10°, flexion contracture of more than 10°, lateral or patellofemoral compartment OA and posterolateral corner insufficiency. Ahlbäck [10] stage 2 chondropathy was observed in six cases and stages 3 in 2. All procedures were performed by a single senior surgeon (J.F.A.) through a one-stage combined technique. Two patients were lost for follow-up: one died for reasons not associated with knee surgery and one refused to participate as he had moved abroad. The result was that eight patients were included in this retrospective transversal study. All patients had a minimum follow-up of 10 years, unless revision arthroplasty was performed before. Demographic data are presented in Table 1.

Operative technique

A tourniquet was placed on the thigh; however, it was not activated systematically. Skin incision was lengthened distally to access hamstring tendons. Semitendinosus and gracilis tendons were harvested and doubled over to obtain a 4 strand autograft. A mid-vastus approach was performed in all cases. Instrumentation was performed with the Genesis unicompartmental knee replacement (Smith & Nephew, Inc, Memphis, TN) in the first seven cases and the Accuris Uni Knee System (Smith & Nephew, Inc, Memphis, TN) in the last patient. In all cases, the bone tunnels for the ACL replacement were performed after the UKA bone cuts and with the trial implants in position. Thereby, the risk of impingement between both structures and tibial plateau weakening was minimized. Both tunnels were created by an out-in technique: reference guides were set at 55° for the tibial tunnel and 110° for the femoral (Arthrex, Naples, FL). The ACL graft was passed through both tunnels and fixed on the femoral side (staple in the first six patients, interference screw in the next 2). The UKA definitive components were then inserted. All patients received a fixed-bearing tibial component, seven cases were metal-backed and one all-poly. Both tibial and femoral components were cemented in all cases. The tibial side of the ACL replacement was then fixed (only staple in four patients, only interference screw in one and staple + screw in three). Variation between patients was due to technique evolution and not because of patient specific indication. An intra-articular drain was positioned for 24 h. Wound was closed with bioabsorbable sutures and skin staples.

Table 1 Demographic data

Age at surgery	52 years (42–60)
Follow-up	175 months (117–258)
Gender	Five male, three female
Side	6 left, 2 right
Height	1.68 m (1.5–1.78)
Weight	77 kg (60–92)
BMI	27 (24–30)

BMI body mass index

Clinical analysis

Personal satisfaction rating was recorded in a range between 0 and 10. At the last follow-up all patients completed the WOMAC osteoarthritis index, they were examined to calculate the Knee Society Score (KSS) and a visual analogue scale (VAS) was performed for pain (range 0–10: 0 for no pain, 10 for severe pain). The results obtained were compared to preoperative data. Range of motion and knee stability, assessed by the Lachman and pivot-shift tests, were also obtained preoperatively and at the last follow-up.

Radiological analysis

Preoperative, immediate postoperative and final follow-up images were performed. Radiological study included weight bearing anteroposterior and lateral views, and an axial view at 30° of knee flexion. The Schuss view was obtained preoperatively to enhance the loss of articular cartilage in the damaged compartment [11]. Anterior tibial translation (ATT) was assessed pre and postoperatively as a sign of ACL deficiency: two lines were drawn tangential to the posterior border of the upper tibia and the femoral condyle, the distance between both lines was considered as ATT (positive values for anterior tibial subluxation) [12]. For the anatomical femorotibial axis calculation, a line was drawn from the femoral shaft center point to a point between the tibial spines and a second line bisected the mid-shaft of the tibia; the angle between both lines was considered as the anatomical axis [13]. ACL deficiency was confirmed by MRI in four patients. Radiolucencies are described by the anatomical region in which they were observed. Signs of progression were analyzed and classified as physiological or pathological as described by Tibrewal et al. [14] (Fig. 1).

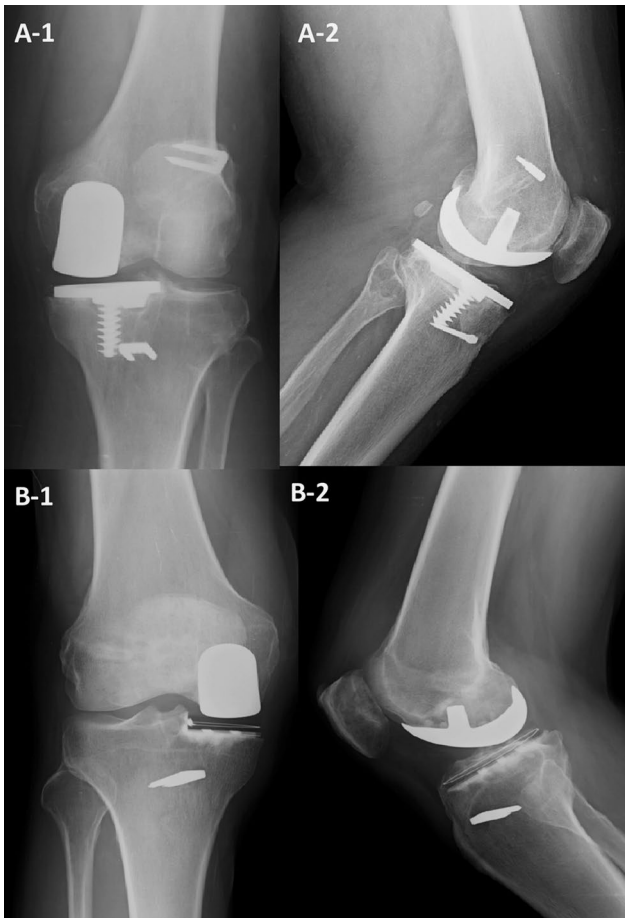

Fig. 1 Anteroposterior (**1**) and lateral (**2**) radiographs of two patients treated in a different fashion. A metal-back tibial component was implanted in the first case (**a**) and ACL replacement was fixed with staples only. An all-poly tibial component was placed in the second case (**b**) and ACL replacement was fixed with interference screws in both sides and an additional staple in the tibial side

Statistical analysis

Data is expressed as mean and range. Statistical analysis was performed using SPSS version 18. Distribution of data was assessed by the Kolmogorov–Smirnov test, showing a data distribution not similar to normal. Therefore, differences in quantitative variables were analyzed by Mann–Whitney's test. The significance level was set at $p < 0.05$.

Results

Clinical analysis

Mean follow-up period was 175 months (117–258). Patients were very satisfied with the evolution of their knees, with a mean of 8.8 points (4–10) of personal satisfaction. Clinical scores improved significantly compared to preoperative scores (p value < 0.01 for WOMAC, KSS and VAS). Mean range of motion increased from 110° (60–130) to 120° (110–130). Two patients had an extension lag less than 10°. One patient's Lachman test was positive, and in another one, it was increased but with a firm endpoint. Pivot-shift test was negative in all cases. None of the patients reported clinical instability (Table 2).

Radiological analysis

ACL replacement did not produce any statistically significant correction of ATT after surgery ($p = 0.37$). Progression of lateral compartment OA was observed in two patients: one was the patient needing revision to TKA and the other one was asymptomatic. Lucency lines were found in two patients. They were located in the anterior part of the tibial component and were classified as physiological, as they did not increase with time (Table 3).

Complications

There was one patient needing revision surgery to TKA at 117 months of follow-up. Clinical evolution was satisfactory over a period of 9 years, when a traumatic contusion due to an accidental fall led to pain in the knee. A conventional Profix total knee system (Smith & Nephew, Memphis, TN) was implanted, and a 16 × 60 mm tibial stem was attached to increase metaphyseal stability. Intraoperatively, ACL reconstruction tear and tibial component loosening were observed (Fig. 2).

Table 2 Preoperative and postoperative results for three clinical scales, shown as mean and range

	Preoperative	Postoperative	Progression
KSS	94 (62–165)	154 (102–200)	60 (30–104)
WOMAC	59 (3–81)	26 (1–52)	32 (2–60)
VAS	8 (6–10)	3 (0–7)	4.6 (1–6)

Table 3 Results for radiological analysis

	Preoperative	Postoperative	p value
ATT	1.6 mm (− 5 to 8)	− 0.9 mm (− 10 to 8)	0.37
Femorotibial axis	181° (177–185)	187° (183–190)	0.003*
Radiolucencies		2/8	

Femorotibial axis: mean and range (< 180° for varus, > 180° for valgus). Radiolucencies: number of patients where radiolucencies were observed ($n = 8$)

ATT anterior tibial translation, mean and range

*Statistically significant

Fig. 2 Radiological evolution of the only patient needing revision surgery to TKA. In the early postoperative image (**1**, **2**), a 19° posterior slope of the tibial component was detected. At 9 years of follow-up, lateral subluxation of the tibia is observed, secondary to tibial component loosening and knee instability (**3**). Final image after revision to TKA (**4**)

Another patient reported knee pain after 13 years of follow-up. Postoperative VAS was 7, WOMAC was 52, and KSS was 120. Personal satisfaction rate was 4. Neither worsening of the rest of compartments nor radiolucent lines were detected in radiographs. At last follow-up, the patient refused to have revision surgery.

At 34 months of follow-up, an arthroscopy was carried out for external meniscus tear repair in a patient with lateral knee pain. ACL reconstruction remained intact, and no progression of OA was observed in the lateral and patellofemoral compartments. Postoperative evolution was satisfactory.

Discussion

The present study demonstrates outcome of combined UKA and ACL reconstruction can be satisfactory, in the mid-term, for patients with concomitant knee instability and unicompartmental OA. Nevertheless, two cases of clinical deterioration were observed in the long term, turning the convenience of this technique controversial.

In the only patient needing revision to TKA, an intraoperative alignment error of the tibial component was detected from the immediate postoperative radiograph. Assessment of posterior slope was 19°. Tibial component implantation is recommended in a slope not exceeding 7° in order to reduce force in the ACL [15]. We believe this alignment error was the main reason for failure. Recent reports show high rotational alignment variability of the tibial component in UKA [16] and the relevance of an accurate placement of components for the survival of the prosthesis [17]. Indeed, combining an ACL replacement in such a demanding technique implies an additional challenge for any surgeon. Therefore, care should be taken when indicating this procedure, poorly reliable for non-experienced physicians and highly demanding even in hands of expert surgeons.

In the present study, the long-term failure rate was higher than expected and this fact could discourage surgeons in the decision-making process. However, we believe several advantages should be considered regarding the convenience of the combined technique. Firstly, no early failures have been reported in the current study, as the two patients with adverse outcome were satisfied for 9 and 13 years. Deterioration occurred at the age of 67 in both cases, which we consider more adequate for TKA than the ages of 58 and 54, when the combined procedure was carried out. Therefore, this technique contributed a good interim solution for these patients and should be considered as an alternative to preserve knee function and bone stock in young patients. Secondly, a standard TKA, without any requirement of intramedullary stem or reconstruction for bone loss, can be performed in most of the UKA revision surgeries [18]. Reports analyzing outcome of primary TKA compared to TKA after UKA revision are controversial: On the one hand, Levine et al. [19] describe clinical results of 31 cases of revision of failed UKA as comparable to primary TKA with similar-length follow-up periods. On the other hand, Järvenpää et al. [20] report less satisfying outcome of a 21 patients cohort after UKA revision, compared to primary TKA. Consequently, stronger evidence is needed regarding the suitability of the combined technique as an interim procedure in case of failure. Finally, the better range of motion [21] and preservation of natural knee kinematics [22] by UKA in comparison with

TKA can significantly improve patient's quality of life. In our opinion, this is the reason why the combined technique could be indicated in younger patients. Reliable survival rates have not been obtained yet, and patients should be informed about the risk of early failure. In older patients, TKA remains as the gold standard technique. On the basis of the lower demand of activity and a more limited life expectancy in older patients, the better long-term survival rates for TKA should be considered first.

Pandit et al. [5] describe results of 15 patients treated by medial UKA and ACL reconstruction, at a mean follow-up of 2.8 years. Excellent clinical outcome is observed, and clinical improvement was not significantly different to the control cohort of patients operated on for UKA, with an intact ACL. Weston-Simons et al. [6] report an update of the latter study, with the biggest sample in medical literature, 51 patients. Both techniques were performed simultaneously in 33 cases and staged in 18. At a mean follow-up of 5 years (1–10), clinical results were excellent (Oxford knee score: 41, global KSS: 160). Only two patients required conversion to TKA, one due to infection and one for progression of lateral compartment OA. Tinius et al. [7] present a series of 27 patients treated with concomitant medial UKA and ACL reconstruction. At 4.4 years of mean follow-up, clinical outcome was satisfactory and no revision surgery was needed. In all the studies, authors express their concern about the potential longevity of results.

The two failure cases in this report were the only ones presenting a positive Lachman test in physical evaluation. Moreover, ACL failure was confirmed in the revision surgery of one of these patients. Therefore, the integrity of ACL replacement after the combined procedure could be suggested as an object of concern regarding arthroplasty survival. Tinius et al. [7] report the correction of ATT after ACL replacement combined to UKA. Authors suggest it might be associated with reduced edge loading and therefore less polyethylene wear. Pandit et al. [5] also describe the absence of pathological posterior femoral subluxation after the combined procedure. On the other hand, persistence of chronic anterior subluxation of the tibia after the combined procedure has already been described by Dervin et al. [8]. In the current study, the postoperative correction of ATT was only 2.5 mm, which was not found statistically significant ($p = 0.37$). Although the small sample size could explain the absence of significant differences, the insufficient correction of ATT could also be proposed as a reason for failure. Postoperative stability of all knees was assessed by physical examination. Thus, the lack of an accurate device to measure knee instability could be proposed as a limitation of this study.

The limited sample size is a serious limitation for the awareness of the real evidence supporting this technique and further studies with larger sample sizes are needed. However, as indications for the combined technique are selective, limited references can be found in literature and our data could contribute to future studies. Differences in follow-up periods, material of components or design of the prosthesis could be reasons in themselves for bias in results. The loss of two of the ten patients is another limitation.

The strength of this study is the report of long-term results. All patients have a follow-up period longer than 10 years and the mean time is 14.6 years, longer than any previous report to our knowledge. Hence, this is the first description of the complications observed in the long term after combined UKA and ACL reconstruction. The failure rate was higher than expected, and we believe it can be considered as a valuable contribution for surgeons' decision-making process.

Conclusions

Combined UKA and ACL reconstruction can be a therapeutic option for patients with concomitant knee instability and unicompartmental OA. It should be considered as an alternative to TKA in young and active patients, aiming to preserve knee function and bone stock. The procedure is highly demanding and reliable only in hands of experienced surgeons. Overall, satisfactory outcome can be achieved at a minimum follow-up of 10 years. In cases of mid-term deterioration, this technique contributed a good interim solution and revision could be carried out with a standard TKA. Deterioration of results is observed in the long term and patients should be informed about the early failure risk in the decision-making process.

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Compliance with ethical standards

Conflict of interest Outside the submitted work, Dr. J. F. Aragón reports personal fees and non-financial support from the Smith & Nephew company. The rest of authors declare that they have no conflict of interest.

Statement of human rights This study was carried out at the Fundació Hospital de l'Esperit Sant (Santa Coloma de Gramenet, Spain) and was approved by the institutional review board and ethical committee of the United Catalonian Hospitals Foundation (Barcelona, Spain), with the code CEIC 15/102. All procedures performed in these studies were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent All patients were informed about the study and gave informed consent to the work. No dead patient was included in the study.

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