Articular cartilage defects in weight-bearing joints, due to trauma or other conditions, often fail to heal on their own and may be associated with pain, loss of function, disability, and long-term complications such as osteoarthritis. Chondral lesions may naturally occur in osteochondritis dissecans (OCD). Improved diagnostic procedures like magnetic resonance imaging (MRI) and arthroscopy have demonstrated that chondral lesions are quite frequent, even in persons without symptoms: at least 5% of cases of traumatic haemarthrosis [1] are associated with chondral defects, confirmed in 63% of arthroscopies [2]. Some traditional surgical procedures, such as endoarticular washing, shaving and debridement, provide relief from pain, locking and swelling, while there are others, such as Pridie’s sub-chondral perforation and Steadman’s microfracture, which can generate cartilage but only of the fibrous type, having biomechanical properties that are inferior to the original hyaline cartilage. Even restoration with osteochondral grafts has its limitations, which often depend on the size and depth of the defects, the dead space between circular grafts and integration of the donor and recipient hyaline cartilage [3].
With the development of autologous chondrocyte implantation (ACI), research by Smith [4], Aston and Bentley [5] and Brittberg et al. [6] has led to a new biotechnological treatment of cartilage defects. The clinical outcome, the histological evidence and, more recently, the results of randomised controlled studies have demonstrated better recovery of the cartilage defects in patients treated with ACI-based techniques, rather than by mosaicplasty [7] and microfracture [8]. Over the last few years, great strides have been made in research on ACI applications and ACI-based surgery, and now a second generation of autologous chondrocyte implantation called MACI (matrix-induced autologous chondrocyte implantation; Verigen) has become available. This technique is based upon the growth of chondrocytes directly on a collagen I-III matrix, and the cells can perfectly differentiate in the matrix three-dimensional environment [7, 9]. At a second surgical procedure, the chondrocyte-loaded matrix’s fixed to the defect with fibrin glue, so much so that it is no longer necessary to saturate the periosteal flap to the cartilage, as was the case in the original technique. With the MACI procedure, we have treated patients suffering from chondral lesions, which were sometimes associated with other pathological conditions of the joint. We followed their clinical course by using a standard evaluation protocol. This report summarizes the preliminary results obtained from the treatment of 36 knees that had a follow-up of at least of 6 months.

Materials and methods

In accordance with International Cartilage Repair Society (ICRS) guidelines, 56 consecutive patients with chondral knee defects were selected from September 2000 and, after informed consent was obtained, we treated the cartilage defects with MACI. Nineteen of 56 patients had less than 6 months of follow-up and their data are not reported here. Two patients did not adhere to the scheduled visits and so were considered as drop-outs. Thirty-five of 56 patients (23 male, 12 female) adhered to the scheduled visits and consequently were included in this analysis: all the data reported here refer to these 35 patients, aged 33.1±7.9 years (range, 18–51 years). One of them who had bilateral osteochondritis dissecans had both his knees treated. The mean follow-up of these patients was 22 months (range, 6–39 months). Patients were treated according to the ethical standards outlined in the Helsinki Declaration.

Surgery was performed in two stages. Initially, an arthroscopy was carried out and the lesions were evaluated if they were suitable for MACI. Nineteen of 56 patients had less than 6 months of follow-up and their data are not reported here. Two patients did not adhere to the scheduled visits and so were considered as drop-outs. Thirty-five of 56 patients (23 male, 12 female) adhered to the scheduled visits and consequently were included in this analysis: all the data reported here refer to these 35 patients, aged 33.1±7.9 years (range, 18–51 years). One of them who had bilateral osteochondritis dissecans had both his knees treated. The mean follow-up of these patients was 22 months (range, 6–39 months). Patients were treated according to the ethical standards outlined in the Helsinki Declaration. Surgery was performed in two stages. Initially, an arthroscopy was carried out and the lesions were evaluated if they were suitable for MACI. At the arthroscopic examination, a slice of cartilage (roughly 200 mg), extending down to the subchondral bone plate, was harvested from a non-weight-bearing area. The biopsy was placed in a nutrient medium and shipped to Verigen Laboratories (Leverkusen, Germany and Kastrup, Denmark) together with 100 ml of the patient’s venous blood. Chondrocytes were enzymatically separated from their matrix, the cells were cultured, loaded on the collagen I-III matrix (Fig. 1a) and then expanded over 3–4 weeks, until a density of $1 \times 10^6$ cell/cm$^2$ was obtained. The seeded membrane (MACI) was sent back to the hospital for the second (arthrotomic) surgical stage. The defect was carefully cleaned until healthy cartilage was reached, avoiding perforation of subchondral bone. Haemostasis, if necessary, was obtained with adrenaline. The final defect was measured and MACI was cut to size and fixed over the defect (Fig. 1b) with fibrin glue (Tissucol; Baxter). The stability of MACI was tested with some flexo-extension movements. In knees with a joint-related pathology, our surgical approach was first to correct the existing pathology during arthroscopy and then, after a period of rehabilitation, to correct the cartilage lesions. Such a surgical strategy has now been modified, and we correct all related pathological conditions during the arthrotomic step, in order that patients are subjected to just one rehabilitation period. All of the patients followed the same rehabilitation program, but were differentiated if the lesions had femoral-tibial rather than a femoral-patellae localization. For femoral-patellae lesions, full loading was permitted with the use of an extension-tutor for...