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Factors Predictive of Clinical and Radiological Outcome, and Patient Satisfaction, Five Years Following Matrix-Induced Autologous Chondrocyte Implantation in The Tibiofemoral Knee Joint

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Summary:
Improved 5 year clinical outcome following MACI is most influenced by better pre-operative SF-36 scores, shorter duration of symptoms and accelerated post-operative rehabilitation, while younger patients, shorter duration of symptoms, fewer prior knee procedures and a smaller graft are most influential on MRI-based outcome. Patient satisfaction was most influenced by accelerated rehabilitation.

Abstract:
Introduction:
Matrix-induced autologous chondrocyte implantation (MACI) has become an established technique for the repair of full thickness chondral defects in the knee. However, little is known as to which pre-operative factors are predictive of post-operative clinical and graft outcome, as well as overall patient satisfaction with the surgery. The aim of this study was to investigate the contribution of pertinent pre-operative patient, chondral defect and injury/surgery history factors to clinical and radiological outcome, as well as patient satisfaction, at 5 years following MACI.

Methods:
This retrospective analysis was undertaken in 104 patients with complete clinical and radiological follow up pre-surgery and up until and including 5 years post-surgery, following MACI surgery to the femoral or tibial condyles. Following a review of the literature, a range of pre-operative factors that had previously demonstrated association with post-operative clinical and graft outcome were selected for investigation. The Lysholm score was selected as our clinical evaluation tool at 5 years, while high resolution magnetic resonance imaging (MRI) was used to evaluate graft assessment. An MRI composite score was calculated by individually assessing eight pertinent parameters of graft repair, based on the magnetic resonance observation of cartilage repair tissue (MOCART), and then multiplying each individual score by a weighting factor to produce a combined graft score with possible values ranging from 1 to 4. A patient satisfaction questionnaire was completed by all patients at 5 years post-surgery, with possible values ranging from 0 to 100. The contribution of pertinent pre-operative demographics (age, sex, BMI), defect characteristics (graft size and location), injury and surgery history (duration of pre-operative symptoms, number of prior knee procedures), mental (MCS) and physical (PCS) component scores of the SF-36, and activity level (Tegner score), as well as post-operative time to full weight-bearing (8 vs 12 weeks), to 5 year post-operative clinical, radiological and patient satisfaction outcomes, was investigated using linear (MRI) or beta (Lysholm and Satisfaction scores) regression.

Results:
The 5 year post-surgical outcome scores [median (IQR), min-max] were as follows: Lysholm score [84 (22), 40-100], MRI composite score [3.2 (0.7), 1.2-4] and Satisfaction score [83 (37), 0-100]. Satisfaction was moderately and

significantly correlated with Lysholm score (Spearmans rho 0.686, p<0.001) but not with the MRI composite score (Spearmans rho 0.017, p=0.864). Lysholm was not significantly correlated with MRI composite score (Spearmans rho 0.092, p=0.350).

Pre-operative factors univariably associated with a higher 5 year Lysholm score were higher baseline Lysholm score, higher MCS and PCS, shorter duration of symptoms and 8 week (versus 12 week) time to full weight-bearing. In a multivariable model including these variables, only MCS and PCS remained statistically significant predictors of the Lysholm score. An increase in the MCS of 1 SD around the mean value of 51.0 was associated with an increase in the Lysholm score of 3.0 points, while an increase in the PCS of 1 SD around the mean value of 39.0 was associated with an increase in the Lysholm score of 4.5 points. The pseudo-R2 measure of this model was 0.116.

Pre-operative factors univariably associated with a higher 5 year MRI score were younger age, shorter duration of symptoms, fewer number of prior knee procedures and a smaller graft size. In a multivariable model including these variables, only duration of symptoms and graft size remained statistically significant predictors of MRI score. An increase in defect size of 1cm2 was associated with a decrease in the MRI composite score of 0.1, while duration of pre-operative symptoms of >10 years was associated with a decrease in the MRI composite score of 0.5, compared with symptoms of <5 years. The adjusted R2 for this model was 0.134.

The only pre-operative factor univariably associated with a higher 5 year satisfaction score was 12 week (versus 8 week) time to full weight-bearing. A 12 week post-operative weight-bearing period was associated with a decrease in the satisfaction score of 11.5 points. The pseudo-R2 measure of this model was 0.034.

Conclusions:
This study in 104 patients following matrix-induced autologous chondrocyte implantation in the tibiofemoral joint demonstrated that better pre-operative MCS and PCS SF-36 scores, a shorter duration of symptoms and accelerated post-operative rehabilitation are most influential on a better clinical outcome at 5 years, while younger patients, a shorter duration of symptoms, fewer prior knee procedures and a smaller graft size are most influential on MRI-based outcome. Despite the broad range of factors investigated, multivariable models explained only a small proportion of variation in outcomes. Within the factors investigated, an accelerated (though structured) post-operative weight-bearing program was the only factor associated with patient satisfaction.