Journal of Orthopaedics 22 (2020) 48–52

Contents lists available at ScienceDirect

Journal of Orthopaedics

journal homepage: www.elsevier.com/locate/jor

The rational for and efficacy of subchondroplasty in the injured worker

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ARTICLE INFO

Keywords:
Subchondroplasty
BME
Bone marrow edema

ABSTRACT

Objective: Evaluation and treatment of workplace knee injuries with pre existing arthritis is difficult from both a causality and a clinical perspective. The current study evaluates the relevance and treatment of the bone marrow edema (BME) in injured workers.

Methods: 179 patients who injured their knee at work and were found to have arthritis and BME and subsequently underwent subchondral calcium phosphate injections (subchondroplasty) were reviewed.

Results: Radiographic arthritic status was Kellgren Lawrence 3–4 in 56%. Cartilage status was outerbridge III/IV. 86% reported marked improvement at 6 months. 74% at 3 years and 83% at 5 years. RTW was 78% at 3 months & 85% by 6 months. Survivorship was 98% at one year, 86% at 2 years, 81% at 5 years & 76% at 7 years post op.

Conclusions: BME (associated with trabecular fracture) is an objective measure of causality in the injured worker. The treatment of BME positive arthritis in injured workers is highly successful in terms of decreasing pain, improving function and expediting return to work.

1. Introduction

A great deal of the American work force is over the age of 50. In this population there is a high degree of knee arthritis of varying symptomatology. When workers above age 50 suffer knee injuries the treatment, relevance and causality become extremely complicated. Furthermore, TKA in patients treated under work injury insurance has very poor outcomes on knee scores. Approximately < 25% return to work in their preinjury job after TKA[1,2]

Felson and others have demonstrated that the greatest correlation of pain with arthritic findings is related to the presence of Bone Marrow Edema (BME) on Magnetic resonance imaging (MRI).[3,4] They have also demonstrated that it is the greatest predictor of progression of trophic changes related to arthritis an eventual need for Total knee Arthroplasty (TKA).[5–7]

In 2009 Dr's Cohen and Sharkey began applying the injection of calcium phosphate into the subchondral bone in patients with Bone marrow edema awaiting TKA. Subsequently Dr Cohen demonstrated its efficacy in athletes. In 2016 Cohen and Sharkey published intermediate follow up data on non-workers compensation patients demonstrating the sustained efficacy of subchondroplasty.[8–11]

Since 2011 the author has performed subchondroplasty on 248 patients. 72% of these were work injury. This study attempts to delineate the influence of Bone Marrow Edema and its treatment by subchondroplasty in the worker's compensation patient.

2. Materials and methods

One hundred seventy nine worker's compensation patients underwent arthroscopically assisted fluoroscopically guided subchondral injections of calcium phosphate (subchondroplasty) for painful bone marrow edema syndrome (Fig. 1) from 2011 to 2019. The average age was 54.2yrs (23–71). Avg BMI was 34.9 (26–45). One hundred and two were male and seventy-seven were female. Arthroplasty had been recommended in 64% of cases prior to our initial pre-op evaluation. Ninety percent of patients had injections with cortisone or hyluronate prior within 3 months of subchondroplasty. The patients were out of work for an average of 3.8 months (range 2–16 months) at the time of surgery. In 2011 the average pre op oow duration was 9.6 months, in 2018 it was 3 months.

Workers compensation law in new jersey limits contact with injured worker's once maximum medical improvement has been declared thus long term follow up was achieved when patients presented for new injuries to the knee, injuries to other body parts or court ordered re-evaluation.[12]

The Subchondroplasty (SCP) was performed by the same surgeon in all cases. The SCP procedure was a modification of that previously described by Cohen and Sharkey.[8,9] Pre-operative MRI was used to delineate the location of the BME. At the conclusion of the arthroscopy (where any loose bodies or large meniscal flaps or chondral flaps were removed and synovectomies performed) fluoroscopy was used to

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https://doi.org/10.1016/j.jor.2020.03.047
Received 10 March 2020; Accepted 25 March 2020
Available online 27 March 2020

Fig. 1. T2 MRI demonstrating focal bone marrow edema weightbearing aspect MFC.

Fig. 2a. AP radiograph, noting prob marking joint line at site of MRI BME. Canula is drilled from opposite side targeting area.

triangulate the lesion. In contrast to the standard SCR technique, no jigs were used and trocars were drilled trans epiphyseal scar and from the opposite side of the knee in all cases. This was done to minimize risk of over pressurizing the subchondral bone and prevent extravasation into soft tissues. (Fig. 2a–d). Post operatively patients were given crutches weight bearing as tolerated and encouraged to discontinue the crutches as soon as they were comfortable. All patients were pre-authorized for femoral or abductor blocks if needed. They were utilized in 12% of cases due to high pain levels in the recovery room. Physical therapy began at 10–14 days post operatively and continued until maximum medical improvement or full return to work was achieved.

Fig. 2b. Levy technique of subchondroplasty, Lateral radiograph note probe marking joint line canula drilled from opposite side targeting area.

Fig. 2c. technique of subchondroplasty, Lateral radiograph demonstrating calcium phosphate fill.

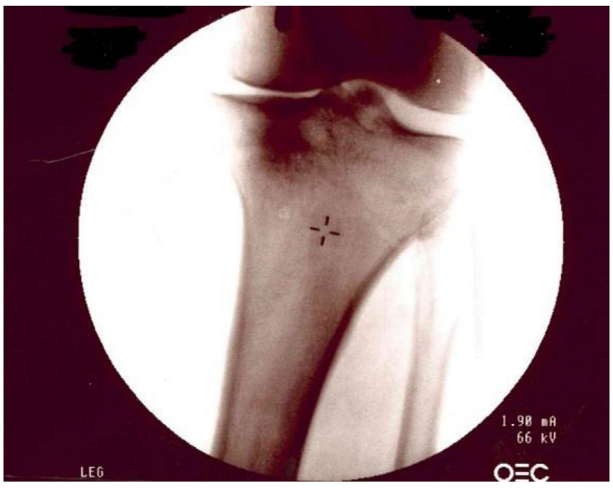

Fig. 2d. technique of subchondroplasty, AP radiograph demonstrating calcium phosphate fill.

3. Results

3.1. Characterization of the cohort

Knees osteoarthritis was radiographically graded according to the Kellgren Lawrence (KL) classification (grade 1 = possible osteophyte formation to grade 4 = bone on bone with large osteophytes).[13,14]

Articular Cartilage status was graded according to the Outerbridge Classification (grade 0 is normal, Grade 4 is exposed subchondral bone).[15]

At the time of index surgery Radiographic arthritic status was KL III/IV in 56%. Cartilage status was outerbridge III/IV in the treated region. 49% of patients had grade III/IV changes in areas not treated with subchondroplasty (due to no bone marrow edema present on MRI). Subchondroplasty was performed in the medial tibia plateau in 76 cases, Medial femoral condyle in 48 cases, combined MFC and medial tibia plateau in 16 cases, Lateral tibia plateau I 22 cases, lateral femoral condyle in 3 cases, Trochlea 9 cases, patella 4 cases and proximal fibula one case.

3.2. Duribility of pain relief following arthroscopicly aided subchondroplasty

Eighty six percent of patients reported marked (VAS reduction of at least 3 points) improvement at 6 months. At 3 years VAS reduction > 3 was 74% and at 83% at 5 years (Fig. 3). Overall VAS improvement at 2 years was 4.7 from baseline with only 3 patients having a marked worsening of symptoms between years one and two. At one year follow up, none of the patients that did not improve (VAS decrease > 3) in first 3 months had improvement after (Fig. 4).

Three patients who had early improvement worsened and required arthroplasty within 2 years.

3.3. Conversion to arthroplasty

Survivorship was 98% at one year, 86% at 2 years, 81% at 5 years 76% at 7 years(Fig. 5). Two (with grade 1 DJD) had second opinions by another physician whereby another MRI was obtained (without our knowledge and without radiologists informed of prior subchondroplasty) and they were diagnosed with osteomyelitis. When bone cultures were negative this was changed to avascular necrosis. Both underwent TKA by another physician and did not improve and did not RTW (Fig. 5).

3.4. Return to work data

All patients had a minimum of 3 months follow up 78% returned to work at their original jobs at this time and were placed at Maximum medical improvement. Additional follow up occurred in this group if they were sent back for recurrence of pain, new injury or court ordered reevaluation. 85% returned to work by 6 months.

Of the 10 WC patients with no subjective improvement by 6 months, Eight (half with Grade 1 djd) had functional capacity examinations that showed significant submaximal effort and they returned to work, 5 at full duty, 3 at modified duty.

Post-operative MR imaging was obtained in 11 workers compensation cases within the first year. Four cases revealed streaming medullary replacement. Fourteen patients had radiographs after two years and they revealed persistent finding of calcium phosphate as late as 4 years.

Hyluronate use was documented in 58% of cases pre-operatively. It was documented to have worked initially then failed in 22 cases and not at all in 36 patients. Twenty-four patients had re-use of single injection hyluronate in first year with 85% documenting improvements in achiness and stiffness.

4. Discussion

Clinicians treating knee injuries in worker's compensation cases face additional complexity in the face of preexisting arthritis. Not only do they need to treat the acute injury, but they need to assess its influence on the preexisting arthritis. This requires them to make decisions regarding the causality of the work injury to the arthritic symptomatology and progression separate from the recovery related to the acute work injury.

Overall Physician diagnosed arthritis occurs in 29.3% of patients aged 45–64 yrs old.[16] The percentage of severe joint pain attributable to arthritis in adults varies by state with rates as high as 46% in Mississippi. Thus, a large percentage of knee injuries in workers will occur in the face of underlying preexisting arthritis. In addition, after 2014 there has been a marked increase in the severity of joint pain reported with documented arthritis with 31% of those in the 45–64yrs reporting it as severe.[17] The importance of this concept is enhanced when one realizes that arthritis is the leading cause of work disability among US

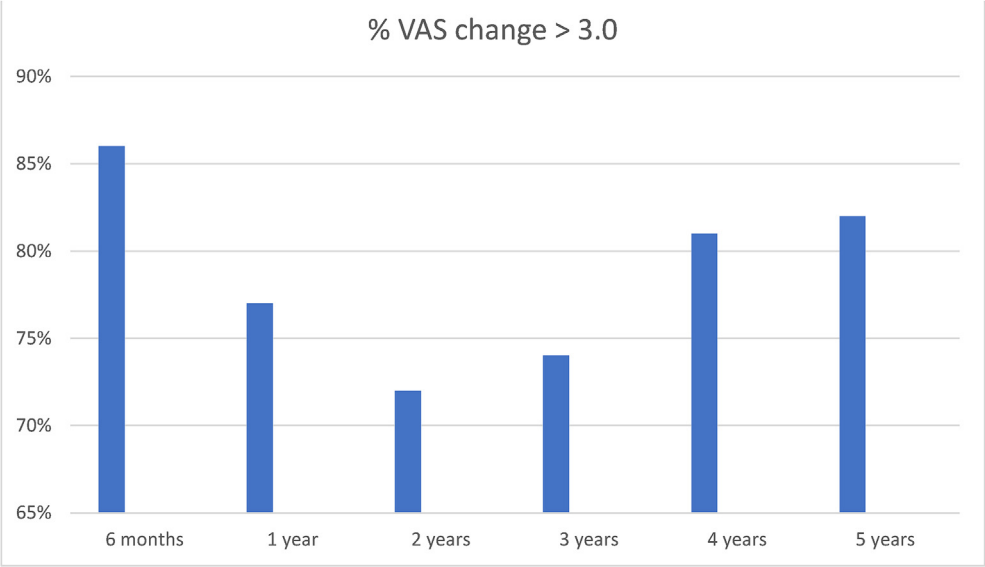

Fig. 3. Percent of Patients Reporting > 3 VAS change.

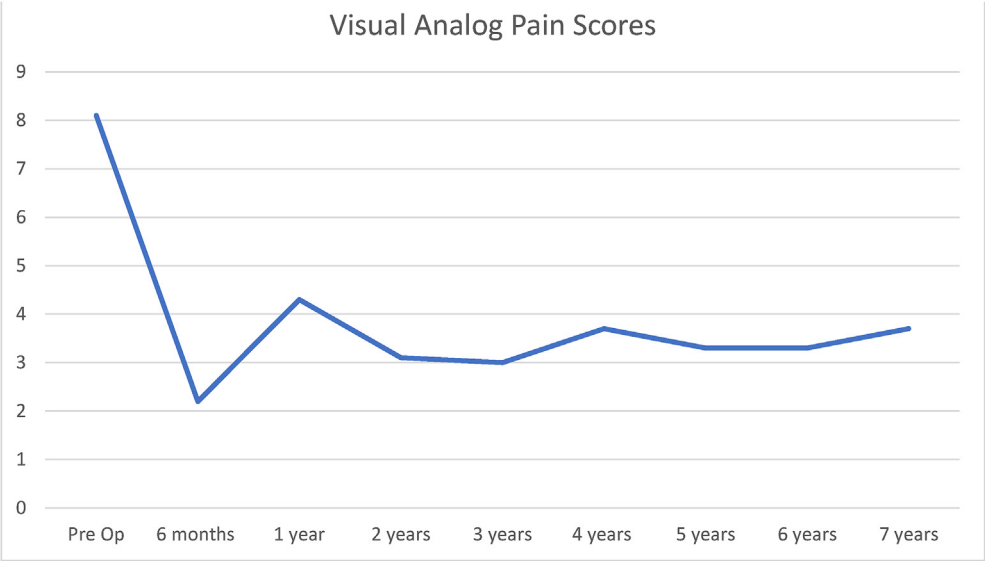

Fig. 4. Average visual analog pain scores.

adults.[18] Furthermore the results of total knee arthroplasty (TKA) in worker's compensation patients are poor. Salah et al. have demonstrated significantly lower outcomes scores (64 vs 92) then non work injury TKA and a less then 25% return to work rate.[1,2] The combination of high prevalence of arthritis in injured worker's knee combined with poor surgical results in this cohort makes having a different less invasive surgical option extremely valuable.

Bone Marrow edema (BME) is described as increased signal on T2 MRI's. It was first described as Bone Bruises associated with ACL tears. In 2000 it was first correlated with arthritis. Subsequently Felson and others have demonstrated direct correlations of presence and magnitude of BME with overall arthritis activity.[3] This includes magnitude of pain, progression of angular deformity and need for arthroplasty.[4–7] When this data is applied to the worker's compensation patient there are significant implications towards causality and likelihood of arthritic progression without injury. In a case where there is radiographic evidence of arthritis and no MRI before the injury. Presence of BME can be considered either direct causality or possible exacerbation. If BME was present on an MRI of the patient's knee prior to the injury, then there is a very high likelihood the arthritis was actively progressing and symptomatic and the care should not continue under work injury. If there is no BME present on the index MRI then it can be concluded that the injury does not include an exacerbation of the arthritis. The value of earlier defined objective causality is that it allows progression of optimal medical care in a timely fashion. In the first month after injury data suggests that about 10% of injured workers seek legal representation, but as time goes on that increases. Increased lawyer involvement is associated with prolonged out of work and costs of overall care.[19] Thus one can conclude that the presence of bone marrow edema is a keystone not only for prognosis of arthritis but also for causality determination in the injured worker.

Bone Marrow Edema, however, is not true edema. Biopsies demonstrated no fluid (classic in edema definition), but instead demonstrated trabecular fractures often with a pattern consistent with nonunion.[20] Empirical conservative care consisting of activity modification, bracing anti-inflammatory medicines and therapy were employed for at least 3 months in all cases. No data exists concerning the overall efficacy of these modalities in the face of BME present arthritis. Less

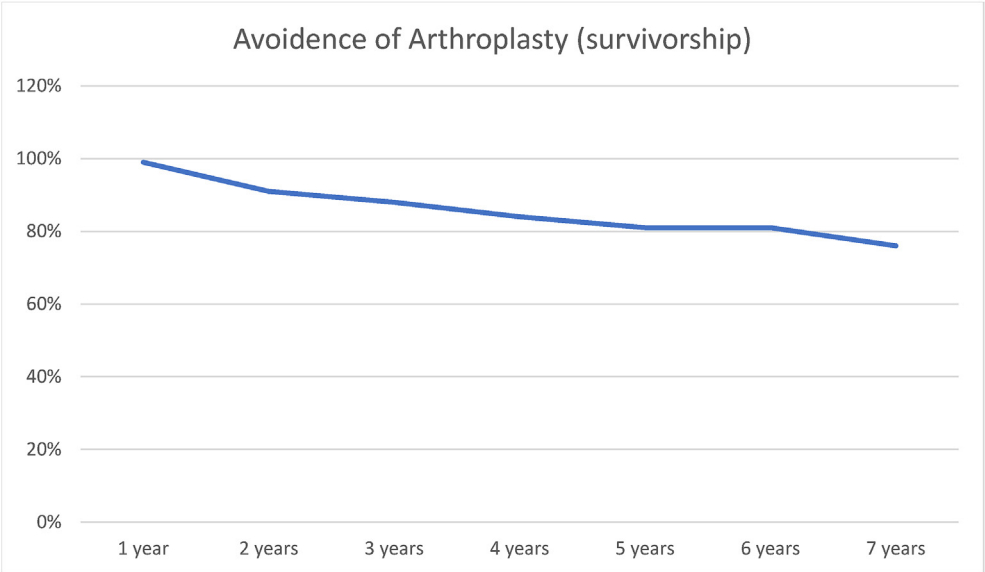

Fig. 5. Survivorship of subchondroplasty.

invasive treatments such as cortisone and hyluronate injections were utilized in many. The lack of predictability in general of these injections becomes clearer when there is documented data that lidocaine injected into an arthritic knee has been shown to produce relief in only 60%.[21]

When conservative care fails surgical care is indicated. In the arthritic knee surgical treatment traditionally consisted of arthroscopic debridement of the arthritis, resection of damaged meniscus and removal of loose bodies. More aggressive treatment includes osteotomy and arthroplasty. In non-worker's compensation situations, the role of arthroscopic partial meniscectomy in advanced arthritis is now not advisable. This is because it produces only temporary relief and often expediates arthritic progression.[22] However none of these studies-based outcomes on the presence or absence of BME. Any surgical option in the presence of bone marrow edema (trabecular fracture/nonunion) should thus incorporate treatment of the subchondral trabecular bone pathology.

Calcium Phosphate has a twenty-year documented history of demonstrated efficacy in reducing pain in fractures, preventing displacement and help expediate healing.[23] In essence subchondroplasty is the treatment of trabecular fractures/nonunion with calcium phosphate designed to flow and set with similar compressive strength properties to the cancellous bone found in the subchondral region.

In a non-workers compensation cohort, Davis et al. documented average 4.7-point improvement on 10-point visual analog scale at avg 15 months post op (range 12.9–25.1 months). They noted 92% survivorship from arthroplasty however they did note 36% benefited from hyluronate in the first 2 yrs.[24] In a non-worker's compensation cohort of 66 patients Cohen et al. demonstrated a 70% survivorship at 2 years with 5.1-point improvement on VAS scores at 4 years.[8–10] In the present study we demonstrated an overall VAS improvement of 4.7 from pre op to 2yrs. We also noted that in the 70% of those who did not go on to TKA this remained fairly constant up to 7 years. This confirms that there is similar efficacy of subchondroplasty in treating pain and dysfunction associated with bone marrow edema arthritis in worker's compensation patients (where arthroplasty results are traditionally poor).

Overall efficacy of hyluronate injections has been questioned recently.[25] The present study demonstrates that treating the subchondral trabecular fractures (BME syndrome) allows intra articular hyluronate to regain or increase its efficacy. This most likely occurs by subchondroplasty removing the primary pain generator allowing the hyaluronates to handle intra articular pathology better. The benefits are clear in the worker's compensation cases where the first injection can thus be considered curative and any repeats (after 6 months) be palliative in delaying or preventing TKA.

We are very cautious in recommending subchondroplasty where there is no DJD and have started combining with bone marrow aspirate concentrate in these cases. As partial meniscectomy was performed in the majority of the knees in this study, the survivorship data suggests that the stabilization of subchondral bone makes the partial meniscectomy less deleterious in advanced arthritis.

4.1. Problems with this study

Follow up under worker's compensation laws in new jersey in some ways led us to have an unusually high rate of longer term follow up. Because 70% of work injury cases that go on more than 3 months have lawyer involvement, there is frequent court ordered or lawyer requested follow ups at 2-year intervals that keeps the cases opened. Additionally, should a patient seek additional knee care the legal system usually includes a reexamination by the physician who performed the prior surgery. However, it also led to decreased quality of the follow up: Unfortunately, the patients are often also advised by these same layers not to be detailed on written questionnaires.

Source of funding

The Center for Advanced Sports Medicine Knee and Shoulder.

Declaration of competing interest

None relevant to this article.

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