JOSEPH BERNSTEIN, MD
Assistant professor of orthopedic surgery, University of Pennsylvania, Philadelphia

TONY QUACH, BA
University of Pennsylvania

A PERSPECTIVE ON THE STUDY OF MOSELEY ET AL

Questioning the value of arthroscopic knee surgery for osteoarthritis

ABSTRACT

Arthroscopy for degenerative conditions of the knee is among the most commonly employed orthopedic procedures, but its effectiveness (like the effectiveness of many surgical operations) has never been proven in prospective trials. Moreover, the precise mechanism by which arthroscopy improves the course of degenerative conditions of the knee has not been established conclusively. Moseley et al performed a double-blinded, randomized, placebo-controlled trial to compare the effectiveness of arthroscopic lavage and arthroscopic debridement vs a sham procedure. Data regarding pain and function were obtained at multiple time points over a 2-year period. The authors found that all three treatment groups fared equally: each reported subjective symptomatic relief, but no objective improvement in function was noted in any of the groups. These data suggest that the benefits of arthroscopy for the treatment of osteoarthritis of the knee is to provide subjective pain relief, and that the means by which arthroscopy provides this benefit is via a placebo effect.

ARTHROSCOPIC SURGERY is frequently employed to ameliorate the symptoms associated with degenerative conditions of the knee. Moseley et al[1] estimate that at least 650,000 such procedures are performed each year in the United States, making it the second most commonly employed orthopedic procedure (ranked behind only arthroscopy of the knee for nondegenerative conditions).

This popularity implies that the operation is well received by both doctors and patients. Nevertheless, its effectiveness (like the effectiveness of many surgical operations) has never been proven in prospective trials, and the precise mechanism by which it may improve the course of degenerative conditions of the knee has not been established conclusively.

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To address these issues, a double-blinded, randomized, placebo-controlled trial was undertaken by J. Bruce Moseley, MD, and colleagues.[1] This study compared the effectiveness of arthroscopic lavage and arthroscopic debridement to a sham procedure. Data regarding pain and function were obtained at multiple time points over a 2-year period.

In this article we will outline the findings of the Moseley trial and some of the interesting questions it raises.

Exactly how arthroscopy relieves knee pain has never been proven

RATIONALE FOR ARTHROSCOPY: MODERATE OSTEOARTHRITIS IS VEXING

Minor symptoms of osteoarthritis of the knee can be managed with pain relievers such as acetaminophen or nonsteroidal anti-inflammatory drugs. Severe, end-stage osteoarthritis can be treated with total joint arthroplasty.

Moderate arthritis—too severe for simple medications but not bad enough to warrant joint replacement—is more vexing. For years, orthopedic surgeons have offered arthroscopic lavage and debridement as treatments for moderate osteoarthritis of the knee.

Why arthroscopy might be effective

In theory, arthroscopy for arthritis should relieve symptoms and even alter the natural history of the disease by several mechanisms. Lavage can remove debris and inflammatory cytokines that cause synovitis.[2,3] Debridement can remove torn meniscal fragments and loose articular cartilage. These steps should minimize mechanical symptoms and improve the distribution of weight on the joint surfaces.[4–7]

Why arthroscopy might not be effective

There are equally powerful reasons to suggest that arthroscopy has limitations:

- Arthroscopy addresses only surface phenomena, and the pathology of osteoarthritis that generates pain may reside far from the surface (for example, deep within the bone)
- The damaged articular cartilage itself may play only a contributory role in the clinical manifestations of the disease: for instance, cartilage has a limited ability to sense pain.
- Because the protective lamina splendens of the articular cartilage is disrupted in osteoarthritis, even if arthroscopic removal of cartilage debris helps the patient, arthroscopy cannot prevent more debris from accumulating. Thus, the benefit of arthroscopy on the basis of "cleaning out" the joint alone is apt to be short-lived.

RATIONALE FOR THE MOSELEY TRIAL

Further clouding the picture is the evidence from prior clinical studies. Many published studies have found that arthroscopy offers a positive effect. Nevertheless, these studies cannot serve as the final word, as one could reasonably deem them methodologically flawed.

For instance, most studies lacked randomization, control groups, and blinding of observers. Also, publication bias may skew the presentation, ie, "positive" studies are the ones more apt to be published.

In sum, prior studies are not definitive.

Moseley et al[1] state "the physiological basis for the pain relief offered by arthroscopy for osteoarthritis is unclear. There is no evidence that arthroscopy cures or arrests the osteoarthritis. Therefore, we conducted a randomized, placebo-controlled trial to assess the efficacy of arthroscopic surgery of the knee in relieving pain and improving function in patients with osteoarthritis."

The premises the authors assert are reasonable. The questions they pose, therefore, are most worthy of study.

STUDY DESIGN AND METHODS

Moseley et al compared the subjective and objective outcomes attributed to arthroscopy for knee osteoarthritis after three types of interventions: arthroscopic debridement, arthroscopic lavage, and sham (placebo) surgery. The primary hypothesis was that the pain level as measured 2 years after the procedure would be no different in the three groups, regardless of the type of intervention.

The protocol was approved by the hospital's institutional review board.

Inclusion and exclusion criteria

Participants were recruited from the Houston Veterans Affairs (VA) Medical Center over a 3-year period. Eligible subjects were all those age 75 or younger who presented to the orthopedic clinic for consideration of arthroscopic management of osteoarthritis of the knee as defined by the American College of Rheumatology, and who had at least moderate knee pain despite maximal medical treatment for at least 6 months.

Patients were excluded if they had serious medical conditions, if they had undergone arthroscopy of the knee within 2 years, or if they had radiographic evidence of severe degeneration or malalignment.

Of the 324 consecutive patients who met the criteria for inclusion, 144 (44%) declined to participate. The remaining 180 were stratified into three groups according to the severity of osteoarthritis. Participants in each of the three severity classes were randomly assigned to one of three treatment groups (see below).

There are good reasons arthroscopy may be effective—or not

The operations: Lavage, debridement, and sham surgery

Dr. Moseley performed all the operations.

Arthroscopic lavage was performed with general anesthesia and included diagnostic arthroscopy and a washout of the joint with saline.

Arthroscopic surgery vs placebo surgery for osteoarthritis of the knee

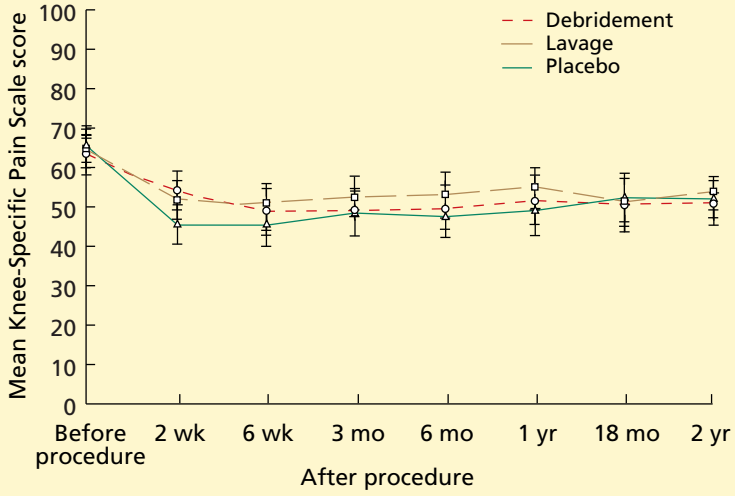

FIGURE 1. Mean values and 95% confidence intervals on the Knee-Specific Pain Scale show similar outcomes in all three groups.

FROM MOSELEY JB, O'MALLEY K, PETERSON NJ, ET AL. A CONTROLLED TRIAL OF ARTHROSCOPIC SURGERY FOR OSTEOARTHRITIS OF THE KNEE. N ENGL J MED 2002; 347:87–88.

Arthroscopic debridement was performed in like manner, but in addition to the lavage, areas of rough articular cartilage were shaved, loose debris was mechanically removed, and torn menisci were trimmed.

The placebo procedure was "simulated surgery": the patient was sedated, prepped, and draped, and incisions were made in the skin, but the joint was not entered. Saline was dripped on the floor and instruments were handed back in forth in case a patient would be able to recall the experience.

In all, 61 patients underwent lavage alone, 59 underwent debridement, and 60 underwent sham surgery. The characteristics of all three groups were comparable.

Postoperative care

Postoperative care was uniform across all groups. The use of analgesics after surgery was similar in the three groups. The patients, the nurses involved with postoperative care, and the study personnel involved with follow-up data collection were blinded to the treatment groups. The surgeon did not participate in any outcome assessment. Postoperatively, participants in none of the three treatment groups were more likely to guess whether they received the placebo surgery.

Follow-up measures

Data were collected at 2 weeks, 6 weeks, 3 months, 6 months, 12 months, 18 months, and 24 months after the procedure.

Pain was measured on a self-reported knee-specific pain scale, with scores ranging from 0 (no pain) to 100 (most severe pain). Additional established scoring systems were used to ensure validity.

Function was assessed via the walking-bending subscale of the Arthritis Impact Measurement Scale, and with a physical functioning scale devised for this study. The physical functioning scale recorded the time in seconds that a patient required to walk 100 feet and to climb up and down a flight of stairs.

RESULTS: PAIN IMPROVED IN ALL GROUPS, FUNCTION DID NOT

Of the 180 patients who started the trial, 16 were lost to follow-up.

All three groups reported an initial decrease in knee pain, an effect that faded somewhat over the 2 postoperative years (FIGURE 1). At no point did arthroscopic lavage or debridement provide significantly greater pain relief than the sham procedure. Indeed, the placebo group reported the greatest net improvement in pain scores on the Arthritis Impact Measurement Scale.

Similarly, all three groups reported equivalent scores for function: on the walking-bending subscale of the Arthritis Impact Measurement Scale, the groups that underwent the true arthroscopic interventions did no better than the group that underwent placebo surgery, and at a few points in time they did worse.

In sum, the Moseley study found:

- All three groups were roughly the same in terms of subjective and objective findings;
- Pain improved subjectively in all three groups; and
- Function did not improve in any group.

STRENGTHS OF THE STUDY

The study by Moseley et al is noteworthy for its inclusion of a sham treatment—a rarity in surgical studies. Using a placebo group is the only way to allow inferences to be drawn about a possible placebo effect.

The study's sample size afforded 90% statistical power: that is, if differences were to exist between groups, it is highly likely that the study would detect these differences. Follow-up was detailed, and fewer than 10% of patients were not included in the final assessment. The design of the study was robust and well conceived.

LIMITATIONS OF THE STUDY

The principal limitation of the study is not a flaw of the study per se, but rather of its context. That is, this was a study from a single institution that included 180 patients, but osteoarthritis affects millions of people. Just as one swallow does not make a summer, one study, however robust, cannot and probably should not turn practice on its head.

Is improvement after acromioplasty also a placebo effect?

Patient selection bias

Moseley et al admit that patients recruited from the Houston VA hospital "may not be representative of all candidates for arthroscopic treatment of osteoarthritis of the knee."[1] The population was mostly male, and the investigators state that they do not know whether their findings would be the same in women, although responses to arthroscopic surgery are not known to differ between the sexes.

Other factors may be even more significant, such as the prevalence of cases involving disability ratings and secondary gains.

The patients' mental bias could also affect the results, at least the subjective outcome measurements.

As the authors point out, 44% of eligible patients declined enrollment because they did not want to take the chance of not undergoing a real procedure. The 56% who did enroll—and who thereby chose to take a one-in-three chance of not undergoing a real operation—may have had such high expectations of arthroscopic surgery that it may have skewed their responses in the subjective outcome measures.[1]

Other limitations

Another limitation of the study is that a single surgeon performed all of the procedures. The authors defended this by noting the surgeon's impeccable credentials, as well as some impressive but irrelevant experience he had (he is the orthopedic surgeon for a National Basketball Association team and was the physician for the US Olympic basketball team—however, candidates for neither position are chosen on the basis of technical proficiency at arthroscopy).

But the question is not one of technical proficiency but of bias. It is possible that (perhaps subconsciously) the operating surgeon did not believe in the effectiveness of debridement and therefore did not try to do the best possible debridement operation. Since there are no videos of the surgeries, this criticism cannot be refuted.

Accordingly, a perhaps better way to compare surgical outcomes in a head-to-head trial is to have surgeons who are advocates of each procedure perform the operation they favor. In that case, there will be no question then that effort was withheld.

The study also did not report preoperative range of motion, nor did it note mechanical symptoms or effusions. At the time of surgery, the pathologic findings were not catalogued and photographed. It must be said in defense of the authors that any bias introduced by differences in these parameters should have been washed out by the randomization process.

Along those lines, one may say that this study may have indeed invalidated the use of arthroscopy for osteoarthritis of the knee in patients who met the study's inclusion criteria but that these inclusion criteria were too broad and arthroscopy based on these indications should be invalidated. That is, the reason this population of patients did not show improvement following arthroscopic surgery was because of poor patient selection. Of course, that raises the question whether all 650,000 operations that are performed annually employ the rigorous indica-

tions the critics suggest (ie, cases of osteoarthritis featuring mechanical symptoms such as locking or effusions, without simultaneous involvement of both the medial and the lateral side).

IMPLICATIONS OF THE STUDY

Since its publication, the Moseley study has caused a great deal of controversy. What are the implications of this study?

Implication 1: Public awareness of placebo effect

The study invites the possibility that the benefits of arthroscopy of the knee for osteoarthritis are due to the placebo effect. Since arthroscopy is such a common procedure, this is big news. Indeed, the *New York Times* ran an article about the study on the front page,[8] and all major media picked up the story. As a result, many patients were made aware of a placebo effect of surgery. What impact this will have on patient attitudes (given that in this country people spend tens of billions of dollars each year on alternative medicine) remains to be seen.

Implication 2: Fewer arthroscopies

The *New York Times* front-page report of the Moseley study findings appeared under the headline "Arthritis surgery in ailing knees is cited as sham."[8] Because of this and other similar articles, the Arthroscopy Association stated that the "casual reader of these articles might think that arthroscopic surgery is useless for any type of knee surgery involving arthritis."[9]

This would be unfortunate. Still, many physicians may become more reluctant to recommend arthroscopy (at least for the short term). More than that, the Department of Veterans Affairs (which sponsored the Moseley study and therefore can be confident that the results apply to its population) has issued an advisory to its doctors recommending that they not perform arthroscopy for osteoarthritis of the knee without clear clinical evidence of significant derangement or symptoms due to anatomic and mechanical abnormalities.

Implication 3: Other procedures called into question

If the placebo effect plays a role in the outcome of knee arthroscopy for osteoarthritis, does it also play a role in other procedures offered for pain relief, such as spinal fusion for axial back pain and acromioplasty for shoulder impingement?

Implication 4: Possible effects on reimbursement

The authors conclude that "if the efficacy of arthroscopic lavage or debridement in patients with osteoarthritis of the knee is no greater than that of placebo surgery, the billions of dollars spent on such procedures annually might be put to better use."[1]

Well, maybe. When doctors treat arthritis, they are attempting, foremost, to offer subjective improvement. After all, the reason patients come to them is because of a subjective complaint: pain. If arthroscopy offers subjective improvement, regardless of mechanism, it can be deemed successful.

Accordingly, one should state that funds may be put to better use only if there is a cheaper means to achieve that benefit, but the authors did not show this. After all, a placebo benefit is still a benefit. The obvious question is whether this benefit could be attained at lower cost and with lower risk.

Even a placebo benefit has value

Implication 5: Personal observation is limited

Because a subjective benefit was reported across all groups, a surgeon monitoring his or her own practice (and observing such subjective happiness) would be correct in concluding that arthroscopy provides real benefit.

But that conclusion could be wrong. The perceived benefit could be a placebo effect or simply a manifestation of the natural history (that is, the waxing and waning) of the disease.

The lesson from the Moseley study is that only with control groups and blinded observers can one make definitive statements about the effectiveness of a treatment. Personal observation of one's own practice is obviously the first step toward evidence-based medicine, but it is clearly not the only step either.

Implication 6: The value of arthroscopy must be proved

All other commentary notwithstanding, the value of "cleaning out" the arthritic joint with arthroscopic surgery, in the absence of painful lesions defined preoperatively, has certainly been called into question. The challenge is now made for researchers to repeat the Moseley methodology, taking into account the various criticisms, and demonstrate the effectiveness of arthroscopy. In at least a small measure, the burden of proof has shifted.

REFERENCES

1. **Moseley JB, O'Malley K, Peterson NJ, et al.** A controlled trial of arthroscopic surgery for osteoarthritis of the knee. N Engl J Med 2002; 347:87–88.
2. **Evans CH, Mazzocchi RA, Nelson DD, Rubash HE.** Experimental arthritis induced by intraarticular injection of allogenic cartilaginous particles into rabbit knees. Arthritis Rheum 1984; 27:200–207.
3. **Smith MD. Triantafillou S, Parker A, Youssef PP, Coleman M.** Synovial membrane inflammation and cytokine production in patients with early osteoarthritis. J Rheumatol 1997; 24:365–371.
4. **Baumgaertner MR, Cannon WD Jr, Vittore JM, Schmidt ES, Maurer RC.** Arthroscopic debridement of the arthritic knee. Clin Orthop 1990; 253:197–202.
5. **McLaren AC, Blokker CP, Fowler PJ, Roth JN, Rock MG.** Arthroscopic debridement of the knee for osteoarthritis. Can J Surg 1991; 34:595–598.
6. **Sprague HF III.** Arthroscopic debridement for degenerative knee joint. Clin Orthop 1981; 160:118–123.
7. **Jennings JE.** Arthroscopic debridement as an alternative to total knee replacement. Arthroscopy 1986; 2:123–124.
8. **Wald ML.** Arthritis surgery in ailing knees is cited as sham. New York Times 2002 Jul 11;Sect. A:1 (col. 6).
9. **Burkhart SS, Ewing JW.** Knee arthroscopy for osteoarthritis. Arthroscopy Association of America position paper. Available at **www.aana.org/membership/OAposition.html**. Accessed February 4, 2003.

ADDRESS: *Joseph Bernstein, MD, Department of Orthopedic Surgery, University of Pennsylvania, 424 Stemmler Hall, Philadelphia, PA 19104; e-mail orthodoc@post.harvard.edu.*