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CME

The Effectiveness of a Pain Wrap Compared to a Standard Dressing on the Reduction of Postoperative Morbidity Following Routine Knee Arthroscopy: A Prospective Randomized Single-Blind Study

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Abstract

A pain wrap dressing in patients undergoing routine knee arthroscopy was evaluated to determine its ability to decrease postoperative pain and swelling. Bilateral knee examinations were performed pre- and postoperatively. Patients recorded narcotic usage and pain levels for 10 postoperative days. Twenty-four patients completed the

study. The pain wrap group had lower pain ratings (2.2 versus 4.6 [$P=.03$]) and demonstrated lower skin temperatures (1.1°F versus 3.9°F [$P=.02$]). Less postoperative swelling was noted in the treatment patients, whereas postoperative arc of motion and narcotic usage was similar in both groups.

Routine knee arthroscopy is a minimally invasive procedure. However, patients frequently require postoperative narcotics and experience significant discomfort related to the healing response that mimics an acute inflammatory reaction. In addition to subjective reports of pain, symptoms include postoperative stiffness, warmth, and joint effusion. Various modalities such as cold and compression have been investigated and concluded to be effective in reducing this response.¹⁻⁴ However, these "cryotherapy" devices are expensive, ranging between \$250 and \$500 and often are not covered by insurance carriers.

Additionally, the cold units are cumbersome and associated with an inherent risk of frostbite and the potential for nerve palsy developing in exposed areas.^{5,6} An alternative cost-effective method that reduces the postoperative morbidity related to the inflammatory response would be of value to patients undergoing joint-related surgery.

This study evaluated a pain wrap whose mechanism of action is believed to work by absorbing sodium ions from the skin. A decrease in sodium from the area of a surgically induced incision is believed to inhibit the activity of the nociceptive nerve endings, the nerves responsible for pain transmission from the outer epidermis.^{7,8}

Nociceptors sense trauma to the skin through thermal, mechanical, and chemical trauma.^{9,10} Nociceptive impulses travel through the dorsal root ganglion of the spinal cord to the brain.^{9,11} Blocking this neural pathway is believed to inhibit the inflammatory response

potentially leading to reduced pain, stiffness, warmth, and joint effusion.¹⁰

This study determined whether the pain wrap reduced the postoperative inflammatory response including total postoperative pain, stiffness, warmth, and joint effusion following routine elective knee arthroscopy.

MATERIALS AND METHODS

Institutional review board approval was obtained prior to patient enrollment. Consecutive patients indicated for knee arthroscopy were eligible for enrollment after obtaining informed consent. Indications included unilateral knee pathology of the meniscus or articular cartilage indicated for arthroscopic treatment and the absence of allergies to wound dressings or adhesives.

Patient Population

The enrollment efforts and reasons for patient attrition are shown in Table 1. A total of 49 consecutive patients

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TABLE 1

Patient Enrollment and Reasons for Attrition

Enrollment Efforts	
Patients consented for study	49
Patient Attrition	
Cancelled surgeries	4
Ineligible surgical procedures	11
Microfracture	7
Meniscus repair	3
Arthrotomy	1
Postoperative assessment forms not returned/unreadable	4
Office failures	4
Withdrew	2
Total	25*
Total no. patients enrolled and analyzed	24

*No. patients not included in the analysis.

who met the inclusion criteria were enrolled from April 2000 through March 2001. Preoperatively, all patients underwent a complete bilateral knee-related physical examination that included goniometrically measured range of motion, assessment for swelling and effusion based on joint girth, and measurement of skin temperature using a DermaTherm (Sharn Inc, Tampa, Fla) temperature strip.

At the conclusion of arthroscopy, a surgical assistant opened a randomization envelope indicating the type of dressing the patient was to receive. The treating surgeon remained blinded to the dressing type selected and left the operating room during dressing application.

Study Groups

Immediately following knee arthroscopy, the treatment group received a sterile 1×1-inch Polymem (Ferris Manufacturing Corp, Burr Ridge, Ill) dressing square over each arthroscopic incision followed by a 48-inch Ferris Pain Wrap (Ferris Manufacturing Corp) placed circumferentially around the knee (Figure 1). The control group received a stack of five 4×4-inch gauze squares placed over the incisions followed by a cotton gauze wrap placed around the knee. Both dressings were



Figure 1: Patient with Polymem dressings (A) and the Pain Wrap (B) after knee arthroscopy.

secured with an elastic bandage.

Postoperative Care and Knee Pain Assessment

On discharge, all patients were provided with an additional control or Pain Wrap dressing with thorough instructions describing how to perform a dressing change on postoperative day 2.

Patients were asked to complete a postoperative knee pain assessment form and a postoperative analgesic use form on a daily basis for the first 10 postoperative days. Patients were asked to rate their average daily pain at the same time each day on a 10-cm visual analog scale. A mark at the 0-cm end indicated "no pain" and a mark at the 10-cm end indicated the "worst pain imaginable." Similarly, all patients were provided with a single prescription of regular strength hydrocodone/acetaminophen tablets with instructions to take 1-2 tablets every 4-6 hours only as needed. No other pain medications were prescribed, and patients were asked to avoid taking any other medications that would decrease pain or inflammation (ie, nonsteroidal anti-inflammatory drugs, acetaminophen, etc). The total daily number of pain pills ingested was recorded.

Patients were telephoned on postoperative day 2 by the study coordinator and were asked if they experienced any difficulty changing their dressings or completing their forms, or if any adverse events had occurred. Patients were instructed to remove all dressings

on postoperative day 8. Patients were instructed to return for their first postoperative visit on or approximately 10 days postoperatively for suture removal and collection of the same objective measures performed preoperatively (range of motion, swelling, and skin temperature) by the treating surgeon (B.J.C.) who remained blinded to the dressing type.

Statistical Analysis

Data were analyzed using chi square and two-tailed *t* tests with the SPSS software package (SPSS Inc, Chicago, Ill). Results were considered statistically significant when $P \leq .05$.

RESULTS

Eleven patients were eliminated from the study at arthroscopy because more extensive surgery was required than allowed by the protocol. Four patients failed to return their postoperative pain assessment and analgesic forms, and therefore were eliminated from the analysis. Two patients withdrew from the study stating lack of efficacy of the Pain Wrap. Four patients did not complete the study due to office failures including: 2 patients who did not return for follow-up, 1 patient who failed to receive additional dressings at hospital discharge, and 1 patient whose postoperative examination data were not recorded. Therefore, a total of 24 patients completed this study, 12 in each group.

No significant differences existed between the Pain Wrap and control

TABLE 2
Demographic Data

	Pain Wrap	Control	P Value
Gender			.50
Male	6	5	
Female	6	7	
Age (y)			.49
Mean	42.3	46.7	
	± 14.4	± 16.1	
Range	18-62	24-76	
Weight (lbs)			.79
Mean	202.3	206.7	
	± 48.5	± 49.9	
Range	128-290	145-330	
Knee treated			.50
Right	4	5	
Left	8	7	

groups regarding gender, age, weight, or the side treated (Table 2). Both groups were similar in terms of the distribution of surgical procedures performed and the operating time required to complete the arthroscopic procedure (Table 3).

Physical Examination

Mean time from surgery to follow-up was 12.2 ± 3 days for the treatment group and 10.9 ± 1.7 days for the control group. A blinded examiner (B.J.C.) assessed patients bilaterally for swelling, range of motion, and skin temperature. Objective measurements were made of both knees using a tape measure to determine joint circumference at the central patella, a goniometer to measure range of motion, and a DermaTherm temperature strip to measure skin temperature (Figure 2).

The circumference of both knees taken at the middle of the patella was measured in centimeters and the side-to-side difference was calculated using the contralateral knee as an internal control. The Pain Wrap group measured 0.56 ± 1 cm compared to 1.08 ± 1 cm in the control group. This trend toward less postoperative effusion and swelling in the treatment group was not statistically significant ($P=.22$).

Preoperatively, mean side-to-side difference in the total arc-of-motion was similar for the treatment group

TABLE 3
Distribution of Surgical
Procedures

Procedure	Pain Wrap	Control
Medial meniscectomy	8	6
Lateral meniscectomy	1	2
Cartilage debridement	3	5
Cartilage biopsy	1	1
Loose body removal	1	0
Plica excision	0	1
Lateral release	0	1
Synovectomy	0	1
Average arthroscopy time (min)*	31.8	37
	± 15.3	± 12.3
Range	12-60	15-60

* $P=.35$.

($6.7^\circ \pm 5.7^\circ$) compared to the control group ($8.7^\circ \pm 5.7^\circ$). At postoperative follow-up, the control group had a similar mean side-to-side difference in the total arc of motion measuring $22.5^\circ \pm 15^\circ$ compared to the Pain Wrap group measuring $26.8^\circ \pm 18.8^\circ$ ($P=.56$).

Preoperatively, both groups had similar side-to-side differences in skin temperature. Postoperatively, the Pain Wrap group demonstrated significantly lower mean side-to-side differences in temperature ($1.1^\circ\text{F} \pm 2.6^\circ\text{F}$) compared to the control group ($3.9^\circ\text{F} \pm 3.0^\circ\text{F}$) ($P=.02$).

Patient Self-Reported Pain Scores and Narcotic Usage

The 10-day average knee pain rating for the Pain Wrap group was 2.2 ± 2.6 (range: 0-7.5) compared to the control group that averaged 4.6 ± 2.5 (range: 0.9-9.4) ($P=.03$). The overall mean pain scores for both groups are presented in Figure 3. Figure 4 illustrates the pain scores for each of the 10 postoperative days for both groups. As expected, pain scores decreased over time for both groups. The Pain Wrap patients had lower pain scores each day compared to controls. Overall, the Pain Wrap scores are statistically lower than those of the control group.

No difference was noted in the amount of narcotic pain medication used by each group. The Pain Wrap



Figure 2: Measurement of skin temperature.

group used an average of 18 pills (range: 0-48 pills) compared to 19 pills (range: 0-52 pills) used by the control group ($P=.46$). Pain Wrap patients used narcotic pain medication for an average of 5.3 ± 3.8 days compared to 5.1 ± 3.3 days for the control group ($P=.77$).

Adverse Events

No patient demonstrated a topical allergic reaction to the Pain Wrap or control dressing. One patient reported a heat-type rash that developed beneath the Pain Wrap that occurred while performing postoperative physical therapy. This rapidly resolved when the Pain Wrap was removed and the area was exposed to the air. Several patients also informed the study coordinator that they were having difficulty performing their exercises while wearing the Pain Wrap. To remedy this, patients were instructed to remove the Pain Wrap while performing their exercises and reapply it once exercises were completed.

DISCUSSION

The main objective of this study was to determine whether the Pain Wrap decreased the postoperative morbidity associated with routine knee arthroscopy compared to a standard postoperative dressing. Both groups were comparable in terms of the surgery performed and their demographic factors. Reports of postoperative pain and skin temperature measurements were significantly reduced in patients wearing the Pain Wrap compared to the standard dressing. A trend toward reduced postoperative swelling was noted in the

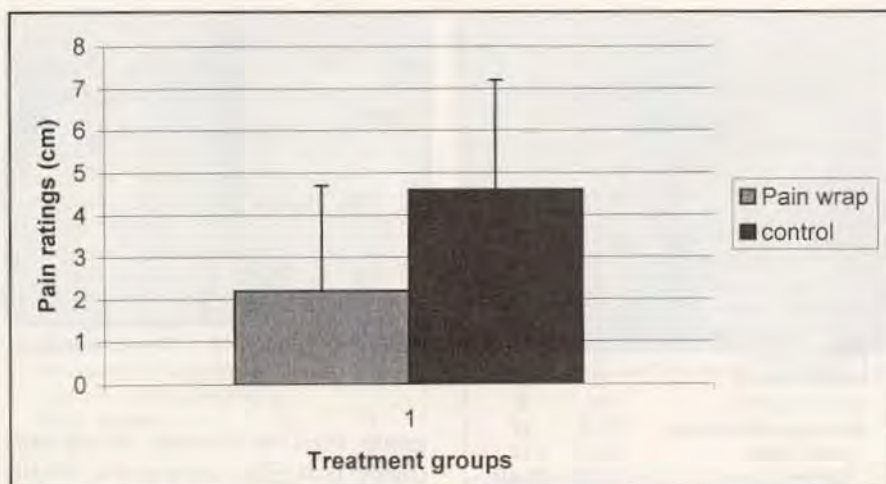


Figure 3: Mean pain ratings.

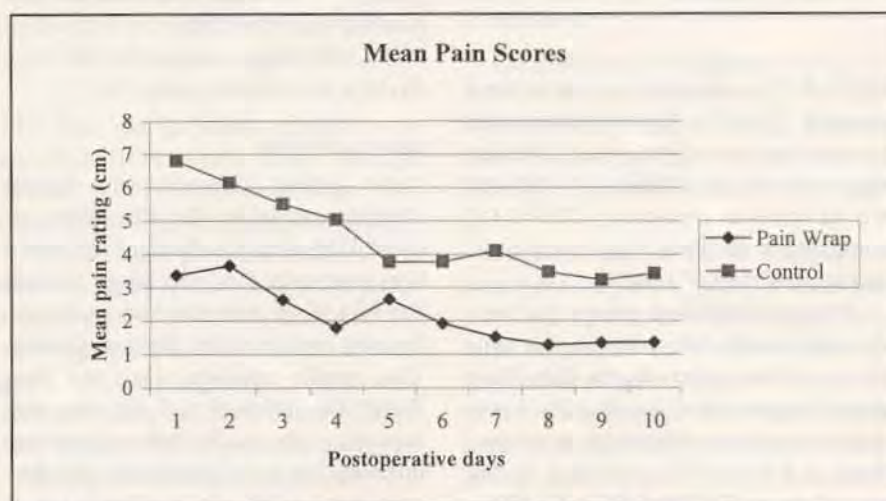


Figure 4: Patient self-reported mean postoperative pain scores.

Pain Wrap group, but this difference was not statistically significant. The control group had slightly improved range of motion over the Pain Wrap group, but also was not statistically significant. It is likely that a failure to significantly reduce swelling contributes to the similar postoperative ranges in motion in both groups. Fortunately, early measures of swelling and motion do not reflect the ultimate recovery of knee motion after the acute postoperative period (ie, approximately 3 weeks). The statistically significant reduction in postoperative pain in the Pain Wrap group is most likely due to the biologic effects of the Pain Wrap and not to postoperative narcotic usage, as both groups demonstrated similar

narcotic intake over the same period.

Nociceptive impulses travel through the dorsal root ganglion of the spinal cord to the brain. Additional nerve fibers are recruited in the dorsal root ganglion that stimulate a release of neural peptides into the peripheral tissues. Specifically, the release of calcitonin gene-related peptide causes vasodilatation of the precapillary arterioles, leading to tissue inflammation. The release of the tachykinin substance P acts on the postcapillary venules causing plasma extravasation leading to the ultimate release of histamine into the tissues and tissue swelling.^{7,8}

Additional studies of these mediators have been conducted. One study demonstrated that when sodium ion pumps of

cutaneous nociceptors were blocked, a corresponding block to cold temperatures occurred.¹⁰ Another study examined postoperative pain in response to tissue injury and swelling in patients undergoing tooth extraction. Patients were given either a placebo, an anti-inflammatory, or a substance P antagonist. Those patients who received the anti-inflammatory and substance P antagonist had significant pain relief compared to the placebo group.¹²

Although the precise action mechanism of the Pain Wrap is still under investigation, preliminary data suggest the dressing absorbs sodium from the outer layers of the epidermis. Less sodium results in hyperpolarization of the nociceptors and thus no action potential to notify the dorsal root ganglion of the pain stimulus.⁸ Patients in our study experienced reduced postoperative morbidity including less pain and reduced temperature most likely due to inhibition of the inflammatory response resulting from the local reduction in sodium concentration and substance P from the Pain Wrap.

The cost of the Pain Wrap is approximately \$100 for two dressings, substantially less than cryotherapy units, and is easier to implement. Because of the relatively short-term nature of the postoperative symptoms associated with routine knee arthroscopy, we do not implement cryotherapy units due to their expense. Additionally, cryotherapy units generally are restrictive in terms of knee motion and require removal during physical therapy to accommodate range of motion exercises. The Pain Wrap posed a similar problem, but to a lesser degree. Removing the wrap while exercising easily accommodates this limitation.

No significant adverse events were reported due to the Pain Wrap, a benefit over superficial tissue damage, frostbite, or nerve palsy reported with the use of cryotherapy units.^{5,6} However, direct comparisons of the Pain Wrap to devices that provide cold and compression will determine the relative benefits and efficacy of each modality.

The Pain Wrap is a cost-effective modality that reduces the early components of the inflammatory response (ie, heat generation) and the postoperative pain associated with routine knee arthroscopy. Larger populations of patients may lead to statistically significant reductions in narcotic usage and swelling and improved range of motion. Ongoing investigation and comparative studies to other modalities such as cryotherapy are anticipated.

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EDITORIAL DISCUSSION

ORTHOPEDICS: What other modalities can orthopedic surgeons use to minimize pain after routine knee arthroscopy?

Hayden & Cole: Several options for managing post-arthroscopy pain exist. Following knee arthroscopy, patients are commonly prescribed narcotic medication or non-steroidal anti-inflammatory drugs (NSAIDs). While appropriate, narcotics have the inherent problems associated with sedation, nausea, and other short-term effects. Although anti-inflammatories are preferable to narcotics, gastrointestinal ulcers/bleed-

ing and increased bleeding at the operative site lead surgeons to avoid NSAIDs postoperatively. Rofecoxib is the only cox-2 inhibitor currently indicated for postoperative orthopedic surgical pain. While cox-2 inhibitors are believed to have at most a negligible effect on bleeding times and are more tolerable in patients with a history of gastrointestinal distress, the cost of these medications and lack of insurance coverage can be prohibitive for many patients.¹

Another alternative for post-arthroscopy pain relief is cryotherapy. Patients may use ice packs for 10- to 20-minute increments only and must avoid direct skin application. Another alternative is cryotherapy devices. These devices are cumbersome, expensive, and require coordination between the surgeon's office with insurance companies for authorization and delivery to the operative center or patient. The Pain Wrap (Ferris Manufacturing Corp, Burr Ridge, Ill) proved easy to implement for both the surgeon and the patient.

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