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Immediate Unrestricted Postoperative Weightbearing and Mobilization after Bone Marrow Stimulation of Large Osteochondral Lesions of the Talus

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Abstract

Objective. There remains no consensus on a postoperative protocol following arthroscopic treatment of osteochondral lesions of the talus (OLTs) and most studies report a period of immobilization and nonweightbearing. Outcomes are believed to decrease with larger size. The purpose of our study was to evaluate patients who underwent arthroscopic treatment of large (≥150 mm^2) OLTs with immediate unrestricted weightbearing and mobilization postoperatively. *Design.* Patients who underwent arthroscopic bone marrow stimulation for osteochondral defects were identified. Exclusion criteria included lesions less than 150 mm^2, additional procedures other than ligament reconstruction, incongruent ankle joint, arthritis, and tibial plafond lesions. Postoperatively, all patients were placed into a soft dressing and were allowed immediate weightbearing as tolerated. Patients were considered failures if their AOFAS (American Orthopaedic Foot and Ankle Society) score was less than 80 or if they underwent osteochondral transplant. *Results.* Thirteen patients were available for follow-up. Two patients underwent osteochondral transplant and were considered failures. Of the remaining 11, the average follow-up time after surgery was 33 months (range, 7-59 months). Average age was 37 years (range, 15-56 years), and lesion size averaged 239 mm^2 (range, 150-400 mm^2). Average postoperative scores included foot function index 50 (range, 23-136), visual analog scale 3 (range, 0-8), and AOFAS hindfoot 82 (range, 40-100). The group's overall success rate was 54% (7/13). *Conclusion.* The results of our study are higher than those previously published studies on large lesions with a more restricted postoperative rehabilitation, suggesting that unrestricted weightbearing and range of motion does not diminish patient outcomes. *Level of Evidence*: IV, Case series.

Keywords

arthroscopy, rehabilitation, outcomes, osteochondral lesions of the talus

Introduction

Osteochondral lesions of the talus (OLTs) are a common cause of pain and disability. Most of these lesions can be attributed to a traumatic event such as a sprain, but some are idiopathic. For those lesions that remain symptomatic beyond 3 to 4 months postonset, nonoperative measures produce high failure rates.[1-3]

Initial surgical treatment options for OLTs are often performed arthroscopically, oftentimes using a bone marrow stimulation (BMS) technique. BMS appears to best optimize patient outcomes when compared with debridement alone.[1,4,5] Although there are differing techniques such as curettage, microabrasion with a shaver, and microfracture or drilling, no consensus exists regarding the most successful method.[1,3,6-9] The bleeding bone produces a fibrocartilage layer at the site of the cartilage defect.[10] This fibrocartilage layer has been shown to have good long-term outcomes despite its inferior durability to the native hyaline cartilage.[15] Results of these techniques are reported to have overall success rates of 80% to 90%.[1,4-6,11-13]

Methods to determine success are variable among published studies, and there is no uniform agreement on an outcome scoring system for talar dome cartilage lesions.[14] The AOFAS (American Orthopaedic Foot and Ankle Society) hindfoot score and a visual analog scale (VAS) are the most commonly reported. There may be discrepancies in how these scores represent patients' pain following BMS for OLT.[5]

There are many variables that have been evaluated to predict outcomes from arthroscopic management. Age, BMI, activity level, sex, lesion location, duration of symptoms, and lesion size have all been evaluated as potential causes of

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worse outcomes,[2,12] with lesion size being the most commonly cited predictor of poor outcomes.[4,6,11] Choi *et al*.[11] identified lesions smaller than 1 cm^2 as having a 94% success, while those greater than 1.5 cm^2 had a significantly higher rate of clinical failure. Although lesion size is strongly predictive of outcome, there is no evidence-based consensus on an absolute size for which arthroscopic treatment would be contraindicated. Studies likewise report that additional procedures such as a lateral ligament reconstruction have not been detrimental to outcomes of arthroscopic treatment of OLTs.[11,15]

The postoperative treatment following arthroscopic management of OLT has not been uniformly determined. Most published studies describe a period of early immobilization followed by up to 6 weeks of nonweightbearing.[2,4,5,11,16] Physical therapy and range-of-motion activities are usually started prior to weightbearing. Lee *et al*.[12] studied patients with early weightbearing at 1 week, finding no outcome difference when compared with control patients who remained nonweightbearing for 6 weeks. All patients had similar arthroscopic techniques and the average lesion size was 1 cm^2. Schuman *et al*.[8] and Chuckpaiwong *et al*.[4] also reported favorable results when limiting weightbearing for less than 2 weeks after surgery.

The purpose of this study was to evaluate immediate unrestricted weightbearing and mobilization following arthroscopic treatment of large ($\geq$150 mm^2) OLTs. We are not aware of any studies that demonstrate detrimental effects on outcomes in patients treated with these parameters. To our knowledge there have been no published studies evaluating the postoperative protocol of immediate unrestricted weightbearing and mobilization after arthroscopic treatment of OLTs. This study is a case series of patients treated with arthroscopic BMS of large osteochondral defects with immediate unrestricted weightbearing and mobilization.

Methods

Medical records and radiographs were reviewed to identify patients who underwent arthroscopic management for OLT performed by the corresponding author. Demographic information was obtained including age, sex, and affected side. Operative notes were reviewed to determine lesion location on the talus, lesion size, any excluding conditions, and additional procedures. Patients were excluded for lesions less than 150 mm^2, additional procedures other than lateral ligament reconstruction, incongruent ankle joint, osteoarthritic changes (identified either on radiograph or arthroscopy), inflammatory arthritis, and adjacent tibial lesions. Patients with lateral ligament reconstruction were included as others have demonstrated no influence on outcomes related to OLT.[11,15] Criteria for lesion size was based on published reports of patients with poorer outcomes with larger OLTs.[11] A follow-up clinical exam was performed and evaluation included 3 standardized scoring instruments: AOFAS hindfoot, foot function index (FFI), and VAS. For consistency and comparison of our results with other reports, we determined success as patients with an AOFAS score of 80 or greater.[11-13] Patients who underwent a subsequent osteochondral transfer after their arthroscopic BMS procedure as a result of pain from their OLT were considered unsuccessful. For consistency in the literature, large lesions were defined as those greater than or equal to 150 mm^2.[11] Informed consent was obtained for each patient in this study.

Surgical Technique

All patients underwent general anesthesia and a thigh tourniquet was used for hemostasis. The operative leg was prepped and draped with the hip and knee bent at approximately 45° with the calf resting on a padded well leg holder. The leg was prepped and draped in standard fashion and Esmarch was used for exsanguination. Standard anterior medial and lateral portals were made. Blunt dissection was used laterally to prevent injury to the superficial peroneal nerve. A standard 4.0 mm 30° scope was utilized.[17] Minimal shaving was performed in the anterior ankle unless synovitis or a plica was identified.

The OLT was identified and delineated with a size-calibrated probe. As needed, the ankle was manually plantarflexed and manual distraction by a surgical assistant was performed for full exposure. Once the perimeter of the lesion was identified, a combination of curettes and arthroscopic shaver were utilized to remove the unstable cartilage to a stable perimeter, remove fibrotic tissue under the lesion, and expose the subchondral bone for BMS. Confirmation of exposing the trabecular bone to allow for adequate bleeding was determined by direct visualization, as well as the presence of bone marrow fat droplets and bleeding. Anteroposterior and medial-lateral measurements of the lesion were determined based on the calibrated markings on the probe and measured in 5 mm increments. Complete arthroscopic evaluation was performed to identify any other sources of joint abnormality. All lesions were accessible using this technique and noninvasive distraction was not needed. Accessory portals were also unnecessary. Lateral ligament reconstruction was performed following arthroscopy when indicated based on preoperative evaluation. Wounds were closed in standard fashion. The corresponding author performed all surgeries.

Postoperative Protocol

Postoperative dressing included a soft roll covered by an ace wrap. When lateral ligament reconstruction was performed, an off-the-shelf stirrup brace was applied over the dressing. This brace permitted plantarflexion and

Table 1. Demographic and Outcome Data for the 11 Patients in the Study Who Did Not Require an Osteochondral Transplantation.

Patient	Age (Years)	Sex	Follow-up (Months)	Lesion size (mm^2)	Lesion Location	AOFAS	FFI	VAS	Radiographic Spurs	Improved
1[a]	15	F	10	150	Lateral	87	38	1	N	Y
2	36	M	43	400	Medial	40	136	8	Y	Y
3	53	M	45	375	Medial	97	23	1	N	Y
4	30	M	39	300	Lateral	90	27	0	Y	Y
5[a]	46	M	50	200	Lateral	100	23	0	N	Y
6	29	M	59	250	Lateral	78	41	4	N	Y
7	45	F	49	225	Medial	100	23	0	Y	Y
8[a]	23	F	7	150	Lateral	100	25	0	N	Y
9	56	M	17	225	Medial	74	53	5	Y	Y
10[a]	30	M	12	150	Medial	85	42	2	N	Y
11[a]	41	M	37	200	Lateral	52	126	8	Y	Y
Average	37		33	239		82	50	3		

M = male; F = female, AOFAS = American Orthopaedic Foot and Ankle Society Hindfoot score (0-100); FFI = Foot Function Index (23-230); VAS = visual analog scale (0-10); Y = yes; N = no.
[a]Patient underwent a concomitant lateral ligament reconstruction.

dorsiflexion. The patient was supplied with crutches, but was allowed to be weightbearing as tolerated. Patients were seen in the office approximately 2 weeks postoperatively for suture removal. Formal physical therapy was then initiated which included range of motion, scar massage, and proprioception. Additional clinical follow-up examinations occurred at 6 and 12 weeks postoperatively and more as needed based on each patient's progress. If the patient had a lateral ligament reconstruction, they continued to wear their stirrup brace until 6 weeks. Impact activities such as running and jumping were allowed at 4 months. Follow-up radiographs were obtained; however, routine postoperative magnetic resonance imaging scans were not performed.

Results

Thirteen patients were included in this case series. The average age was 33 years (range, 15-56 years). There were 10 males (76.9%) and 3 females. The left ankle was affected in 10 (76.9%) patients. Two (15.4%) required a subsequent osteochondral transplant procedure due to persistent pain and were considered an unsuccessful arthroscopic BMS procedure. The articular defect **i**n the patients that underwent osteochondral transplant was identified as the primary source of pain based on positive results from an intra-articular injection.

Eleven patients that did not undergo osteochondral transplant were available for follow-up evaluation (**Table 1**). Average time to postoperative follow-up was 33 months (range, 7-59 months). The lesion size for all patients with available follow-up averaged 239 mm^2 (range, 150-400 mm^2). Five patients' lesions (45.4%) were located on the medial talar dome and 6 had lateral lesions. Lateral ligament reconstruction was performed on 5 (38.4%) patients. There were no wound problems or infections postoperatively.

Postoperative average scores were FFI 50.6 (range, 23-136), VAS 2.7 (range, 0-8), and AOFAS hindfoot 82.1 (range, 40-100). FFI pain, disability, and activity subscales averaged 21.1 (range, 9-55), 21.3 (range, 9-64), and 8.3 (range, 5-20), respectively. AOFAS pain score averaged 26.4 (range, 0-40). Seven (53.8%) of the 13 patients were considered a success based on having a total AOFAS score greater than 80 and/or not undergoing a secondary osteochondral transplant.

Of the 11 patients available for clinical examination, 6 patients (54.5%) reported no pain along the ankle joint line, 3 had mild pain (27.3%), and 1 each had moderate (9.1%) and severe (9.1%) pain. All patients (100%) had joint line pain preoperatively. All 11 (100%) reported "yes" postoperatively that their ankle was "better than before surgery." Five patients (45.5%) demonstrated degenerative changes such as osteophytes on follow-up radiographic studies.

Discussion

Our study suggests that immediate unrestricted weightbearing and mobilization following arthroscopic BMS for large OLTs does not appear to have a negative consequence on patient outcomes when our results were compared to those in the literature with a more restrictive postoperative course.[4,11] In addition, there were no surgical complications such as wounds or infections. To our knowledge, this is the first article that describes outcomes for patients who have had no period of immobilization or restricted weightbearing following arthroscopic BMS for large OLTs. Early mobilization and therapy may have additional benefits to the patient, making the postoperative period easier and possibly facilitating earlier return to work depending on the patient's job description.

Many studies have reported high success rates following arthroscopic BMS techniques for treatment of OLTs, with

an overall good to excellent results in approximately 85% of patients with lesions of all sizes.[2,4,5,11,13,16] All these studies that describe the postoperative care include a period of nonweightbearing for up to 6 weeks. Most also include some form of immobilization in a splint and/or walker boot during the postoperative course lasting as long as 8 weeks. Physical therapy is usually recommended and is oftentimes started before weightbearing is initiated and/or while the patient is still in their walker boot. The primary argument for periods of restricted motion or weightbearing is to protect the healing of the fibrocartilage cap to facilitate cartilage restoration, potentially improving patient outcomes.

Lee *et al*.[12] recently published their study of early weightbearing following arthroscopic BMS for OLTs. They randomized a comparison group of patients that were initially immobilized in a splint and kept nonweightbearing for 1 week. The patients were then allowed partial weightbearing in a walker boot until 2 weeks, when full weightbearing was permitted in a walker boot until 8 weeks, at which time the boot was weaned. Active range of motion and strengthening were started at 2 weeks. This group was compared with a control group that maintained nonweightbearing status for 6 weeks followed by 2 additional weeks of partial weightbearing, being immobilized in a splint for a total of 8 weeks. Demographics of the 2 groups were similar, including lesion size averaging 1 cm^2. There was no significant difference between the 2 groups with regard to AOFAS hindfoot, VAS, and ankle activity scores. The authors concluded that early weightbearing for small to medium OLTs produced similar clinical results when compared with a group managed traditionally with nonweightbearing. Schuman et al.[8] published their results limiting weightbearing for the first 3 to 5 days, reporting good to excellent results in 85% of patients. OLT size was not reported in their study. Chuckpaiwong *et al*.[4] permitted weightbearing after 1 to 2 weeks, with 4 weeks of immobilization in a boot, and reported universally successful results in lesions smaller than 150 mm^2.

There are many variables that have been evaluated to determine their influence on patient outcomes following arthroscopic BMS for OLT. Factors that have not shown a consistent consequence include BMI, lesion location, duration of symptoms, sex, or age.[1,2,4,5,12] Lesion size, however, has been more consistently reported as suggesting larger lesions have a higher rate of pain and disability for the patient.[4,6,11] Chuckpaiwong *et al*.[4] reported 100% success in patients with lesions smaller than 1.5 cm^2, but only 3% (1/32) of patients with larger lesions. Choi *et al*.[11] identified lesions smaller than 100 mm^2 as having a 94% success rate, lesions 100 to 150 mm^2 an 80% success rate, and lesions greater than 150mm^2 a 20% success rate. Clinical outcomes based on AOFAS scores are considered *excellent* if equal to or greater than 90, *good* if 80 to 89, *fair* if 70 to 79, and *poor* if less than 70.[11-13] Using these studies as a basis for lesion size and comparison of outcomes within the literature, in our study we defined a large lesion as greater than or equal to 150 mm^2. With success defined as an AOFAS hindfoot score of *good* to *excellent* (≥80) and/or not having a subsequent osteochondral transplant, our large lesion study group's success rate was 53.8% (7/13). These results are comparable, and possibly superior, to those reported by Choi *et al*.[11] (20%) and Chuckpaiwong *et al*.[4] (3%). Our results suggest a potential improvement in outcomes with unrestricted weightbearing following BMS in patients with large OLTs.

OLT is a subject about which much has been published; however, there is no consensus in the medical community on the appropriate outcome measures. Hannon *et al*.[14] reviewed 24 articles and found comparison of study results to be impossible due to data inconsistencies. There are multiple outcome scoring instruments, including AOFAS hindfoot, SF-36 (Short Form–36),[15] ankle activity,[12] Weber, Alexander, Ogilvie-Harris, and VAS scores.[2,8] Kuni *et al*.[5] reported patient discrepancies in AOFAS scoring, stating the AOFAS questions which were based on certain movements or activities did not accurately describe patients' reports of functional pain in daily life. In other words, the AOFAS score may not reflect the patient's actual clinical and functional state. In addition, the AOFAS hindfoot score has not been validated for outcomes related to treatment of OLTs. Our experience from the current study echoes Kuni *et al*.[5] On follow-up examination, 80% of patients had no pain or only mild joint line tenderness, whereas preoperatively all (100%) had reported joint line pain on examination. In addition, all (100%) patients that did not undergo an osteochondral transplant subjectively reported their ankle was "better than before surgery." We utilized AOFAS hindfoot scale as the best means to compare with other studies in the literature, and not for its value in determining true patient outcomes.

We also evaluated our patients utilizing the FFI, a self-reported questionnaire with 3 subscales: pain, disability, and activity, in which a lower score represents better function. SooHoo *et al*.[21] evaluated patients with the FFI following a variety of foot and ankle surgeries, finding it to be a valid measure of health status and a reasonable method to monitor outcomes. The FFI was initially validated for patients with rheumatoid arthritis, and has been suggested to be unreliable for individuals functioning above their normal level of activities of daily living.[22] Aurich *et al*.[23] utilized FFI in patients who underwent matrix-associated chondrocyte implantation (MACI) for large OLTs, but limited their evaluation to pain and disability to control for their higher functioning patients. The FFI pain and disability subscale results after MACI were 28 and 26, respectively. This is comparable to our group's results in the same subscales of 21.1 and 21.3, respectively.

Kuni *et al*.[5] reported on MRI follow-up at an average of 2 years, with an average decrease in lesion size of only 30%.

They found that absolute healing was poorly correlated with AOFAS scores, and only intensity of postoperative bone edema was associated with persistent pain. On a second look during arthroscopy 1 year following initial BMS, Lee *et al*.[13] found good correlation between AOFAS hindfoot scores and both Ferkel and Cheng stages and ICRS stages of cartilage integrity. They also found that 60% of lesions had a nearly normal appearance of fibrocartilage and that only 30% had complete filling of the defect, particularly at the periphery of the lesion. Therefore, absolute healing of the lesion was shown as unnecessary for good clinical outcomes. Both studies required a period of immobilization and nonweightbearing following surgical intervention.

Furthermore, weightbearing and mobilization after arthroscopic BMS for ankle OLT likely has little negative influence on the fibrocartilage growth and maturation. Most of the biomechanical studies of OLT suggest that the peak pressure lies on the lesions surrounding the hyaline cartilage rim.[18,19] Although fibrocartilage from BMS does not appear to have the same durability as hyaline cartilage, these mechanical studies do not suggest that direct pressure is placed on the lesion. In addition, the constrained nature of the ankle joint is likely a different environment than the knee, which has been suggested to have decreased outcomes with weightbearing following arthroscopic BMS for knee lesions. However, our patients were restricted from repetitive impact activities such as running and jumping for 4 months. This is based on animal basic science models, which show healing cartilage from an osteochondral lesion continued to mature for 16 weeks.[20] This time frame may not correlate in a clinical human model.

The best initial treatment for large OLTs remains controversial. Based on the literature criteria of success, BMS stimulation is universally reported to have substandard outcomes for large lesions. In our study, AOFAS hindfoot scores averaged 82.1 for those patients that did not undergo an osteochondral transplant and total study group constituted a 53.8% success rate based on that criteria. However, results are not overwhelmingly improved when comparing our study's results to cartilage transplant procedures. AOFAS hindfoot scores by Aurich *et al*.[23] averaged 80.4 following MACI; and Imhoff *et al*.[24] and Kim *et al*.[25] averaged 78 and 82 with osteochondral transplant, respectively. Gobbi *et al*.[6] demonstrated no significant difference between microfracture and osteochondral transplant using other outcome scores. All (100%) patients (11/11) who did not have a second procedure felt that they were better than before surgery. Based on the results of the current study, as well as the high cost of osteochondral or chondral transplantation, BMS with unrestricted ROM and weightbearing should be considered as an initial treatment for large osteochondral lesions of the talus. However, patients should be counseled on the possibility of a subsequent procedure if they do not achieve an adequate outcome.

Limitations

There are limitations in our study that require some discussion. Our patients' outcome results did not have preoperative scores for comparison. This limits our ability to accurately delineate the improvement from this postoperative protocol. However, historical reports of preoperative AOFAS hindfoot scores are consistently in the low 60s or below,[11-13] and these are the same studies with which we are comparing our final outcome scores. This demonstrates the benefit of using a consistent scoring system. The purpose of the current study is to demonstrate no negative consequence of immediate mobilization and weightbearing compared with equivalent studies using a more restricted postoperative protocol.

Thirty-one percent (4/11) of our patients had a lateral ligament reconstruction performed at the time of the management for their OLT. Unfortunately, OLTs are generally associated with other derangements that require additional surgical intervention to address the patient's complaints. Lateral lesions, which constituted the majority of our patients (61.5%), have been shown to have a high association with trauma and thus may have additional pathology such as tendon tears and instability.[1,16] This is consistent with our patient population, as only one (25%) patient with concomitant procedures had a medial talar dome lesion, while the remaining 4 (75%) patients had lateral talar dome lesions. Other published literature regarding arthroscopic treatment for medium and large OLTs have a subset of included patients that underwent additional procedures similar to our patients.[11] Choi *et al*.[11] did not find a significant difference when comparing outcomes between groups with and without concomitant procedures. Gregush and Ferkel[15] demonstrated outcomes of patients undergoing lateral ligament reconstruction and arthroscopic treatment of OLT to be similar to patients undergoing only treatment for OLT. Seventy-five percent (3/4) of patients with additional procedures were successful based on the criteria used in this study. This suggests that the outcomes in this study for large OLTs are unlikely influenced by performing a lateral ligament reconstruction.

Finally, our study was a relatively small population without a comparative group. Although our population was not a large sample, it is a relatively similar number of patients published in other studies specifically evaluating large OLTs. A study with a larger patient population randomized into groups of immediate weightbearing versus nonweightbearing could present a better understanding of the appropriate postoperative treatment of patients with large osteochondral lesions of the talus.

Conclusions

To our knowledge, this study is the first to present outcomes of patients that followed a postoperative protocol of immediate unrestricted weightbearing after arthroscopic treatment

of large OLTs. Our study's results suggest that this protocol does not diminish patient outcomes, with results actually higher than those reported by similar studies with a more restrictive postoperative convalescence. A prospective randomized controlled trial would be necessary to provide more conclusive evidence for determining the elements of a postoperative protocol that facilitate the best patient outcomes following arthroscopic BMS for OLTs, and for guiding best practice management of large lesion. The protocol described in this paper may improve patient function during the recovery phase and potentially allow earlier return to work and activity. This postoperative protocol may also be successful for smaller OLTs. Finally, large OLTs pose a difficult and yet unresolved problem for the patient and the surgeon. The future may show that the most appropriate treatment goes beyond BMS.

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Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics Approval

Ethical approval was not sought for the present study because our institutional review board was not available.

Informed Consent

Written informed consent was obtained from all subjects before the study.

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