Arthroscopic Elimination of Monosodium Urate Deposition of the First Metatarsophalangeal Joint Reduces the Recurrence of Gout

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Purpose: To determine if the arthroscopic removal of gouty crystal deposits from the first metatarsophalangeal (MTP) joint will reduce the recurrence rate and improve foot function compared to medical treatment alone. **Methods:** Twenty-eight male patients with hyperuricemia (>7.0 mg/dL) and repeated attacks of gouty arthritis of the first MTP joint were included in this study. Arthroscopic intervention of the first MTP joint was performed on 15 patients (group 1), while the other 13 patients were treated with medication alone (group 2). The follow-up period (mean ± standard deviation) was 3.9 ± 1.1 years in group 1 and 2.4 ± 0.3 years in group 2. **Results:** After treatment, both groups showed a significant improvement in the number of acute attacks of gouty arthritis and in their functional scores on the American Orthopaedic Foot and Ankle Society Ankle-Hindfoot Scale. On both measures, the results for group 1 were significantly better than those for group 2. **Conclusions:** Arthroscopic removal of gouty crystals from the first MTP joint can reduce the rate of acute repeated attacks of gouty arthritis and increase foot and ankle function. **Level of Evidence:** Level IV, therapeutic case series. **Key Words:** Arthroscopy—First metatarsophalangeal joint—Gout—Monosodium urate—Recurrence rate—Tophi.

It is generally accepted that acute attacks of gouty arthritis are provoked by monosodium urate (MSU) crystal shedding or precipitation into synovial fluid. The first metatarsophalangeal (MTP) joint is one of the most common locations of gouty arthritis, and the process of tophaceous deposition advances insidiously. Progressive stiffness and persistent aching of the involved joints are often present. Most patients can be treated with routine oral medications; however, repeated acute attacks may occur because MSU crystals have been deposited within the joint and could result in articular damage.

Open resection of the tophus is complicated by wound breakdown, skin necrosis, and impaired healing potential. A minimally invasive approach of decompression of the tophus has been described to minimize postoperative complications.[1] We hypothesized that elimination of the crystal deposition using a minimally invasive approach under endoscopic visualization might reduce the recurrence rate of acute gouty attacks and improve both foot and ankle function, leading to better results than medical treatment alone. In the present study, a technique is described to treat gouty arthritis of the first MTP joint. The clinical results were evaluated between patients who received this technique and those who received medical treatment alone.

METHODS

Twenty-eight male patients with persistent hyperuricemia (>7.0 mg/dL) and repeated attacks of gouty

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arthritis of the first MTP joint were enrolled in the study. Fifteen patients (group 1) whose symptoms were not relieved by medical gouty therapy after 6 months were selected to undergo arthroscopic intervention (Table 1). The other 13 male patients (group 2) declined operative intervention but continued on anti-gout therapy[2] (Table 2). The exclusion criteria for the surgery group were acute attacks of gouty arthritis with redness and local heat, multiple gross tophi formation, ulceration of the tophus, or signs of infection. The age of all patients in group 1 was 27.2 ± 9.0 years (range, 20 to 49 years). The age of all patients in group 2 was 28.4 ± 6.2 years (range, 20 to 42 years). The duration of symptoms of all patients in group 1 before arthroscopy was 18.1 ± 11.0 months (range, 6 to 48 months). The duration of symptoms of all patients in group 2 before medication was 18.2 ± 8.8 months (range, 10 to 35 months). The uric acid level, number of acute attacks of gouty arthritis, and American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Scale score[3] were evaluated at the latest follow-up visit by an independent observer.

Surgical Technique

The patient's foot was suspended 3 cm over the operating table, and the first MTP joint was placed under traction to spontaneously open the joint space (Fig 1A). The dorsal medial or dorsal lateral portal was established first (Fig 1B). The dorsal medial and lateral portals exchanged their functions as the visualization and working portals, and the removal of tophaceous material under arthroscopic visualization started at the tunnel and proceeded to the periphery of the tophi. A shaver was used to remove the MSU crystals, from the lateral side to the medial side, followed by the sesamoid joints. Small portal wounds were closed subcutaneously with No. 4-0 polyglactin-910 (Vicryl) sutures, and skin closure tapes were applied. The patient was instructed to avoid direct weight bearing for 3 to 4 days. Immediately after surgery, the patient began a regimen of range of motion and strengthening exercises. No cast was needed after surgery. The patient was administered sufficient postoperative medical therapy with a regular regimen of anti-gout therapy[2] to lower the serum urate level to less than 5 to 6 mg/dL and maintain it at that level.

In a case with severe MSU deposition at the first MTP joint with cortical erosion into the proximal phalanx (Fig 2), after arthroscopic removal of crystal deposition, a cancellous bone graft harvested from the medial malleolus of the ankle was used to fill the

TABLE 1. *Details and Clinical Data of Group 1*

Case	Gender	Age (yr)	Side	Duration of Preoperative Symptoms (mo)	Follow-up (mo)	Preoperative/ Postoperative Uric Acid Level (mg/dL)	Preoperative/Postoperative Number of Acute Attacks of Gouty Arthritis	Preoperative/Postoperative AOFAS Ankle-Hindfoot Scale Score
1	M	23	R	24	33	8.8/5.8	6/0	65/89
2	M	22	R	11	41	7.9/7.0	4/0	72/92
3	M	49	L	48	36	8.6/6.4	7/0	68/88
4	M	23	R	32	60	12.3/9.5	8/1	75/92
5	M	45	L	28	49	9.9/8.7	5/1	74/90
6	M	22	R	10	74	9.2/4.5	6/0	64/89
7	M	28	R	12	64	8.5/6.2	4/0	68/88
8	M	21	R	16	60	12.2/9.2	5/1	69/87
9	M	20	R	13	58	9.7/5.3	8/0	65/91
10	M	25	L	22	44	10.5/7.0	6/0	72/92
11	M	21	R	14	40	11.3/6.8	4/0	70/93
12	M	24	R	11	38	9.7/6.3	4/0	66/85
13	M	32	L	15	44	8.9/5.5	5/0	65/88
14	M	33	R	10	33	8.2/4.7	7/0	67/89
15	M	20	R	6	36	9.2/6.3	5/0	72/92
Summary (mean ± SD unless indicated)	15 M	27.2 ± 9.0	11 R/4 L	18.1 ± 11.0	47.3 ± 12.8	9.66 ± 1.37/6.61 ± 1.50 ($P < .001$)	5.60 ± 1.40/0.20 ± 0.41 ($P = .001$)	68.80 ± 3.55/89.67 ± 2.28 ($P = .001$)

Abbreviations: AOFAS, American Orthopaedic Foot and Ankle Society; L, left; M, male; R, right; SD, standard deviation.

TABLE 2. *Details and Clinical Data of Group 2*

Case	Gender	Age (yr)	Side	Premedical Treatment Duration of Symptoms (mo)	Follow-up (mo)	Premedical Treatment/ Postmedical Treatment Uric Acid Level (mg/dL)	Premedical Treatment/ Postmedical Treatment Number of Acute Attacks of Gouty Arthritis	Premedical Treatment/ Postmedical Treatment AOFAS Ankle-Hindfoot Scale Score
1	M	25	L	32	28	8.6/7.2	5/3	64/72
2	M	27	L	11	25	8.2/7.0	7/4	76/78
3	M	38	R	35	30	7.6/6.8	5/3	64/70
4	M	30	R	30	36	9.5/8.5	8/6	70/74
5	M	42	R	22	30	11.5/10.1	9/7	76/78
6	M	20	L	12	26	8.3/6.8	6/4	66/70
7	M	25	R	14	26	7.9/6.5	5/3	70/72
8	M	32	L	13	30	11.3/9.0	4/3	68/74
9	M	28	R	14	28	12.1/9.3	8/6	64/66
10	M	26	R	20	24	10.8/7.8	7/5	74/76
11	M	30	R	12	26	12.6/9.3	6/5	72/78
12	M	22	L	10	32	9.2/7.9	5/3	64/68
13	M	24	R	11	34	8.5/7.3	6/4	64/68
Summary (mean ± SD unless indicated)	13 M	28.4 ± 6.2	8 R/5 L	18.2 ± 8.8	28.9 ± 3.6	9.70 ± 1.73/7.96 ± 1.16 (P = .001)	6.23 ± 1.48/4.31 ± 1.37 (P < .001)	68.62 ± 4.71/72.62 ± 4.11 (P = .001)

Abbreviations: AOFAS, American Orthopaedic Foot and Ankle Society; L, left; M, male; R, right; SD, standard deviation.

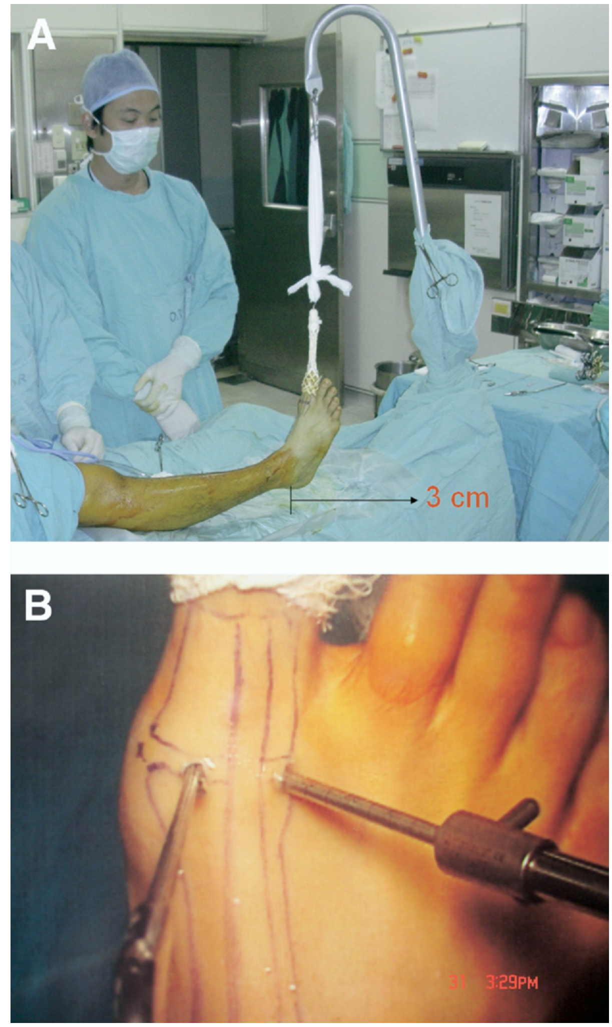

FIGURE 1. (A) The patient's foot is suspended 3 cm over the operating table and a sterile Chinese finger trap is used to place the first MTP joint under traction to spontaneously open the joint space. (B) Two portals are placed at the joint line medial and lateral to the extensor hallucis longus (EHL) tendon.

defect through another incision at the anterior aspect of the proximal phalanx.

Functional Evaluation and Statistical Analysis

Continuous data are presented as means when they are normally distributed. The number of acute attacks of gouty arthritis and the AOFAS Ankle-Hindfoot Scale score[3] were evaluated by an independent observer, and the results were analyzed. The AOFAS Ankle-Hindfoot Scale is an index of the severity of a clinically diagnosed condition. A paired t test was used to compare the pretreatment and posttreatment uric acid levels. The Wilcoxon signed-rank test was

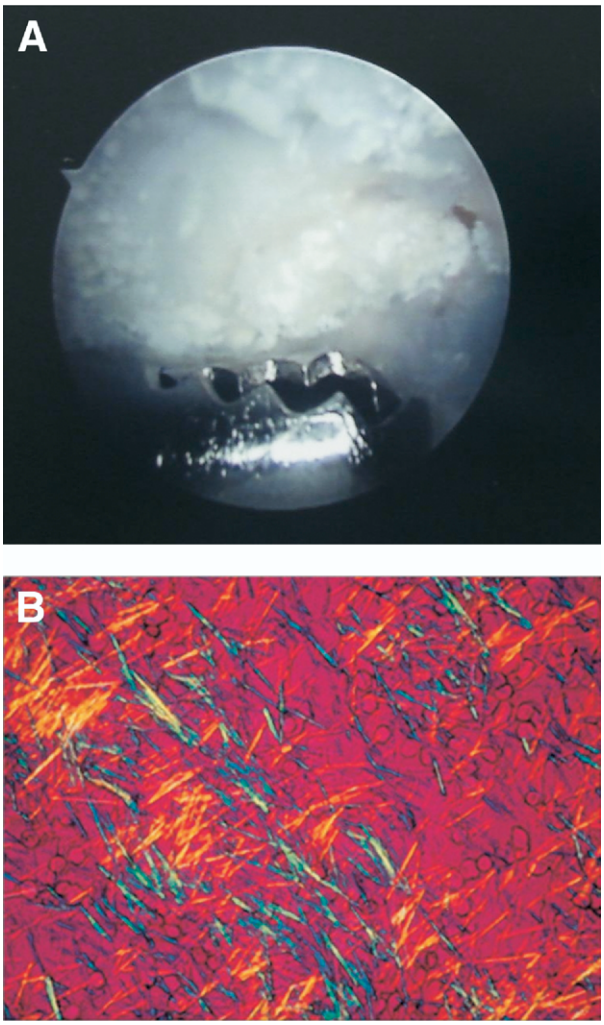

Figure 2. (A) White crystalline material on the articular surface within the first MTP joint noted under arthroscopy. (B) Numerous negatively birefringent needle-shaped monosodium urate crystals are detected by compensated polarized-light microscopy (original magnification ×100).

used to compare the pretreatment and posttreatment number of acute attacks of gouty arthritis and AOFAS Ankle-Hindfoot Scale scores. The Mann–Whitney *U* test was used to analyze differences in posttreatment number of acute attacks and AOFAS Ankle-Hindfoot Scale scores between the 2 patient groups. Statistical analysis was performed with the SPSS software package (version 13.0; SPSS, Chicago, IL). $P < .05$ was considered statistically significant.

RESULTS

The mean uric acid level decreased significantly in group 1 (9.66 ± 1.37 mg/dL *v* 6.61 ± 1.50 mg/dL; $P < .001$) and in group 2 (9.70 ± 1.73 mg/dL *v* 7.96 ± 1.16 mg/dL; $P < .001$). The mean number of acute attacks of gouty arthritis decreased significantly after treatment in group 1 (5.60 ± 1.40 *v* 0.20 ± 0.41; $P = .001$) and in group 2 (6.23 ± 1.48 *v* 4.31 ± 1.37; $P = .001$). The mean AOFAS Ankle-Hindfoot Scale score increased significantly in group 1 (68.80 ± 3.55 *v* 89.67 ± 2.28; $P = .001$) and in group 2 (68.62 ± 4.71 *v* 72.62 ± 4.11; $P = .001$). All patients in group 1 were satisfied with the results of the surgical intervention. The comparison between groups revealed that the mean decrease in number of acute attacks of gouty arthritis was significantly greater in group 1 than in group 2 (5.40 ± 1.40 *v* 1.92 ± 0.49; $P < .001$). Likewise, the mean increase in the AOFAS Ankle-Hindfoot Scale score was significantly greater in group 1 than in group 2 (20.87 ± 2.89 *v* 4.00 ± 2.00; $P < .001$).

DISCUSSION

The indications for arthroscopy of the first MTP joint are the removal of dorsally located endophytes, dorsal impingement syndrome, arthroscopic treatment of osteochondritis dissecans, arthroscopic drainage for bacterial arthritis, removal of a painful sesamoid bone, and arthroscopic treatment of pigmented villonodular synovitis.[4-7] Arthroscopic treatment of osteochondritis dissecans has been shown to yield good results in joints such as the knee and the ankle.[8] Ferkel and Van Buecken[9] reported an 83% rate of good or excellent clinical results for arthroscopy of the great toe.[9]

Gouty arthritis of the first MTP joint is an extremely painful and often recurrent problem. Reducing serum urate concentrations to values below 6.0 mg/dL may prevent acute gouty arthritis, but a reduction to less than 5.0 mg/dL may be required for resorption of tophi.[2] The availability of uricosuric agents and allopurinol has resulted in a significant decline in visible tophi and chronic gouty arthritis.[2,10] When hyperuricemia goes untreated, however, repeated attacks of crystal-induced inflammation result in the erosion of cartilage and subchondral bone, and the tophi may become so severe that surgical intervention is required. Several authors have described the indications for surgery.[11,12] The manual curettage procedure is inefficient because of the hard crystal and fibrotic tissue around the tophi. Furthermore, extensive debridement carries the risk of necrosis of the overlying skin.[11,12] Open surgery around the first MTP joint can result in stiffness, prolonged swelling, poor wound healing, and trouble with footwear.[13]

Between 1993 and 1995, Wang et al.[14] diagnosed and treated 9 cases of first MTP joint gouty arthritis with arthroscopic debridement; satisfactory short term results were seen in all cases. Although arthroscopic debridement cannot replace diet and drug therapy, open eradication of gouty stone, and resection arthroplasty, it could constitute a new treatment method for gouty arthritis.[14]

In our series of patients, the tophaceous lesions were cut into small pieces by the rapidly rolling inner cutting blade through the side port of the shaver tip and simultaneously removed with the suction system. Because the solubility of urate is markedly temperature-dependent, with a twofold increase in solubility between 25°C and 37°C, warm normal saline irrigation was used to reduce the rate of clogging.[15] Normal saline was continuously aspirated along with the tophaceous tissue during surgery. When the shaver is used for lesions of the first MTP joint, nerves and vessels may be injured as a result of the unique characteristics of this instrument. Bimanual palpation and intralesional shaving can minimize the risk of these complications. When tendons, ligaments, and joint capsules are involved, the sharp shaver curettage can be carried out only to a limited degree, and the removal of tophaceous tissue may be incomplete.[1] The branches of the deep peroneal nerve innervate the lateral half of the joint, and the branches of the superficial peroneal nerve innervate the medial half of the joint. The terminal branches of the saphenous nerve innervate the medial aspect of the great toe.[13,16,17] It is essentially a percutaneous procedure, however, with a risk of injury to the nearby nerves and blood vessels.[1]

Surgical removal of the body's uric acid load is more frequently indicated in countries with less aggressive medical management of gout. Even in countries with very aggressive medical management of gout, however, some patients, such as those with kidney disease, are endangered by medical reduction of their tophi; this technique is especially important for this patient population.

The strengths of this study include the precise removal of MSU crystals in a minimally traumatic manner. The study limitations include selection bias, because the decision of whether to undergo surgical or medical treatment was made by the patient, not the researchers. In addition, diet control was not included in the treatment.

Major technological advances in video cameras, fiber optic light transmission, instruments for use in small joints, and joint distraction by noninvasive means—combined with increased knowledge of safe anatomic portals—have improved the ability to perform appropriately indicated diagnostic and operative arthroscopy of the great toe and small joints. Arthroscopic procedures are more difficult in small joints than in large ones, and this approach may not be appropriate for a surgeon who only occasionally performs arthroscopy.

CONCLUSIONS

The arthroscopic removal of gouty crystals from the first MTP joint can reduce the rate of acute, repeated attacks of gouty arthritis and increase both foot and ankle function.

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