INTRODUCTION
Attenuation of the shoulder capsule, where it was found to be subjectively thin and friable, has been described when performing revision surgery upon failed thermal capsulorrhaphy (1, 2). The first goal of this study was to evaluate the histologic findings of the capsule of patients with shoulder instability and to compare them to the capsule of failed thermal capsulorrhaphy. The second goal was to determine if there were histologic findings which would explain the subjective attenuation of the capsule seen at the time of revision surgery in patients with failed thermal capsulorrhaphies.

METHODS
The capsules of six fresh frozen cadavers with no shoulder pathology were used as controls. The capsules from 13 patients with traumatic, anterior instability (dislocators) and from 9 patients who experienced recurrent instability after a thermal capsulorrhaphy (FTC; failed thermal capsulorrhaphy) were studied. All procedures were done through a subscapularis splitting approach (3), and a portion of the mid-portion of the middle glenohumeral ligament was biopsied (Fig. 1). The average time from surgery to revision of the thermal procedure was 12.4 months (range 7-17 months). Specimens were embedded in paraffin, sectioned, stained with hematoxylin and eosin, and examined by a trained musculoskeletal pathologist.

RESULTS
The capsule from the normal shoulders revealed that the capsule consisted of three layers. The first was a synovial layer lining the articular side of the capsule which consisted of two or three cell layers of synoviocytes. The next was a subsynovial layer which had few fibroblasts and loosely packed collagen fibers admixed with adipose tissue (Fig. 2A). The third and thickest layer consists of dense collagen which had a typical wavy pattern. The predominant cell population were fibroblasts and there were sparsely scattered blood vessels.

There were no differences in the gross appearance of the capsules between the dislocator group and the normal group. No apparent thinning was found in the dislocator group. The capsules from the dislocator group showed several differences in the histologic findings of the three layers from those of the normal group (Fig. 2B). In 8 patients (62%), a denuding of the synovial layer where the cell layer was diminished or non-existent was observed and a hyperplastic synovial layer was seen in 2 patients (15%). In the subsynovial layer, eight patients (62%) showed subsynovial edema. Compared to controls, eleven patients (85%) had increased vascularity in both the subsynovial layer and the collagen layer. Increased collagen deposition and fibrosis in the collagen layer was observed in six patients (46%).

In the FTC group, the capsule was subjectively thin and attenuated in 6 patients (67%). There was no discernible differences in the histologic findings of this FTC group according to the preoperative diagnosis. The histologic findings of the FTC group were closer to those of the dislocator group than those of the normal group (Fig. 2C). The histologic findings of the FTC group, similar to those of the dislocator group, included a partial denuding of synovial layer (N=9, 100%), subsynovial edema (N=3, 33%), increased deposit of collagen (N=2, 22%) and increased vascularity (N=8, 89%) (Fig. 2C). The major histologic difference of the FTC group from the dislocator group was the presence of “waxy” or “hyalinized” areas where the collagen had lost its normal, wavy appearance (Fig. D). Four (44%) of the nine patients in the FTC showed partial hyalinization in focal areas and three (33%) showed extensive hyalinization. The FTC group had significantly more specimens with denuded synovium (Phi coefficient=0.451, p=0.034) and hyalinized collagen (Phi coefficient=0.716, p=0.001) than the dislocator group. However, there was no statistically significant relationship between these histologic findings and the subjective impression of attenuation of the capsule (p>0.05).

DISCUSSION
This study demonstrates that collagen morphology can be histologically abnormal for up to 17 months after thermal capsulorrhaphy. Further study is needed to delineate the relationship between failure of FTC, the attenuation of the capsule seen at surgery and the morphological changes seen with microscopy.

REFERENCES

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HISTOLOGIC EVALUATION OF THE SHOULDER CAPSULE IN NORMAL SHOULDERS, UNSTABLE SHOULDERS, AND AFTER FAILED THERMAL CAPSULORRHAPHY

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Fig. 1. A drawing to demonstrate the way of biopsy of the capsule

Fig. 2. Microphotographs of the histologic findings of the shoulder capsule (H & E): A, the control (x60); B, the dislocator group (x40); C, the FTC group (x40); D, the FTC group (x400)