INTRODUCTION

- Predicting the shape and size of rotator cuff tear before the surgery is beneficial to the surgeon, because it enables to perform more detail surgical planning and allow the surgeon to provide prognostic information to the patient.
- A classification of rotator cuff tear shape and size using MRI has been presented. Predicting rotator cuff tear shape and size can be difficult using 2D-MRI [1].
- Three-dimensional (3D) image-based shape model of soft tissue has already applied in various clinical fields.
- In orthopedics, its clinical application would be strongly contributed to improving diagnostic accuracy of rotator cuff tear.
- The purpose of present study was to compare shape and size of torn tendon of rotator cuff in reconstructed 3D-shape model to that intraoperative findings, and to investigate the influence of employing 3D-shape model on accuracy of diagnosis for rotator cuff tear.

METHODS

- MRI scan was carried out for 30 patients with rotator cuff tear before rotator cuff repair.
- The humerus, rotator cuff tear, and rotator cuff tendon were manually traced. (Figure 1)
- 3D-shape models of rotator cuff tendon and torn tendon were acquired using a medical image processing, analysis, and visualization (MIPAV), a standard image processing software.
- Four shoulder surgeons, such as 2 residents (resident G) and 2 experienced specialists, more than 600 case shoulder surgery experiences (shoulder surgeon G) reviewed preoperative shoulder 2D-MRIs and 3D-shape model of rotator cuff tear for assessing shape and size of torn tendon.
- The five rotator cuff tear shapes were categorized in this study: crescent, reverse L, L shaped, trapezoidal, and massive tear (Ellman Classification).
- The four rotator cuff tear sizes were categorized in this study: small < 1cm, medium < 3cm, large < 5cm, and massive > 5cm (Cofield Classification).
- Firstly, the readers characterized rotator cuff tear shape and size by reviewing the 2D-MRI and blind to the intraoperative findings.
- Secondly, the 3D-MRI of each rotator cuff tear was reviewed, and tear shape and size were documented by each surgeon independently and blind to the intraoperative findings.
- These results were compared with the 3D-MRI and intraoperative findings. (Figure 2)
- The Mann-Whitney U test was used to compare two groups.

RESULTS

- The accuracy for tear shape on 2D-MRI was 66.7% for resident G and 76.7% for shoulder surgeon G.
- The accuracy for tear shape characterization using 3D-shape model was 86.7% for resident G and 90.0% for shoulder surgeon G. (Figure 3)
- Moreover, the accuracy for tear size on 2D-MRI was 73.3% for resident G and 90.0% for shoulder surgeon G.
- The accuracy for tear size using 3D-shape model was 93.3% for resident G and 96.7% for shoulder surgeon G. (Figure 4)
- The overall accuracy of tear shape on 3D-shape model was 88.3%, significantly different from the accuracy on 2D-MRI (71.7%) (P<0.05). Furthermore, the overall accuracy of tear size on 3D-shape model was 95.0%, not significantly different from the accuracy on 2D-MRI (81.7%).

DISCUSSION

- In this study, 3D-shape model and 2D-MRI were significantly different in accuracy for diagnosing the shape of rotator cuff tears. Almost reviewers could easily categorize the shape and size of rotator cuff tear by 3D-shape model.
- A previous study showed that the accuracy on 3D-MRI was 82.4%, significantly different from the accuracy on 2D-MRI (64.7%) [2]. There were 1.5T- and 3T-MRI examinations included in the previous study. In this study, the similar accuracy results were obtained, even though we performed 0.4 T-MRI examinations.
- This study has demonstrated that 3D-shape model of rotator cuff tear improved the accuracy of characterizing the shape of rotator cuff tear compare with the current 2D-MRI based techniques.
- Our findings suggest that 3D-shape model of the rotator cuff can work an important instrument for better categorizing and understanding rotator cuff tears, and those providing information that can be beneficial to pre-surgical planning.
- Further studies and these data programing could automatically develop three-dimensional rotator cuff tendon magnetic resonance imaging system and evaluate the shape and size of rotator cuff tear using data mining techniques.

REFERENCES