The Journal of Bone & Joint Surgery

Journal club: 10 April 2012
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Rotator cuff repair failure in vivo: a radiostereometric measurement study.
Baring TKA, Cashman, PPM. Reilly P, Emery RJH, Amis AA.
J Shoulder Elbow Surg 2011;20:1194-99.

Summary

1. Purpose
To monitor the behaviour of the rotator cuff following repair to establish at what point failure may occur by using roentgen stereophotogrammetric analysis (RSA).

2. Methods
The study design was a prospective study in which a series of 10 patients had metal tantalum beads embedded into the greater tuberosity and stainless steel wire marker sutures sewn into the supraspinatus tendon at the time of their open rotator cuff repair surgery. The markers were positioned in an anterior, middle and posterior position in the greater tuberosity and in a corresponding position in the repaired supraspinatus tendon.
Roentgen stereophotogrammetric analysis (RSA) was then used to image the repaired rotator cuffs at five set intervals over the course of the first year following surgery. These were; within 1 hour of surgery, 3-4 days followings surgery, 3-4 weeks following surgery, 12-14 months following surgery and finally at 1 year.
All 10 patients had rotator cuff tears greater than 20mm confirmed on ultrasound examination. Conservative treatment had failed in all cases and each patient had weakness clinically. There were 6 women and four men. The mean age was 55 (range 41-70). None of the patients had any comorbidites.
Each patient underwent an open rotator cuff repair using a transosseous technique with a number 2 Ethibond modified Mason Allen suture technique. A general anaesthetic with interscalene block was used in all cases.
Following closure of the wounds a 15 degree abduction brace was applied. The patients wore this constantly for the first 4 weeks following surgery. At 4 weeks pendulum exercises and assisted passive shoulder mobilization was commenced. Full active movements were commenced at 10 weeks. All RSA measurements were performed with the patient supine wearing the 15 degree abduction brace.

The mean distances between the markers was calculated for each patient and combined to provide a mean marker distance. This was calculated at each subsequent examination and expressed as a change in distance measured compared with the initial post op examination. The results were then compared between those whose repair was intact and those patients in whom the repair had failed or in whom there had been a partial re-tear.
All patients were also assessed using the Constant score and Simple Shoulder Test scores pre-operatively and at 6 months and 12 months following surgery.

3. Results
The findings at surgery confirmed that all 10 patients had full thickness tears involving the supraspinatus tendon.
One patient developed severe CRPS following surgery and was recorded as not having regained any useful shoulder function.
All patients had an ultrasound scan at 1 year following their rotator cuff repair. This revealed that 5 rotator cuff repairs were intact. However, 3 had developed partial tears and 2 complete tears. Both of the complete tears had had massive cuff tears originally.
The mean Constant score had improved from 37 pre-operatively to 53 at 6 months and 62 at 12 months following surgery. The mean Simple Shoulder Test score had improved from 4 pre-operatively to 7.5 at 6 months and 8.6 at 12 months.
In terms of the RSA measurements; the stainless steel marker sutures in the supraspinatus tendon had fragmented in 3 patients between 3 months and 1 year following surgery and consequently only 7 patients had RSA data at 1 year.
The RSA data showed movement of the markers in all patients at each time interval with an overall increase in the distance between bone and tendon markers during the year following surgery. The mean change at 3 days was 0.3 mm, the mean change at 3-4 weeks was 1.2 mm, the mean change at 12-14 weeks was 7.0 mm and at 1 year was 7.8 mm.
The authors found a significantly larger marker movement in the failed or partially torn cases than in those in whom the repair was still intact.

4. Conclusions
The authors concluded that there was marker movement in all rotator cuff repairs and suggested that this indicated either gap formation at the repair site or stretching of the re-implanted tendon. There was significantly more marker movement in the tendon markers of those patients in whom the repair had failed.
They also concluded that their study provided convincing evidence that rotator cuff repairs are most vulnerable to failure in the second and third months following surgery and noted that this period was also when the physiotherapy was most intense. The authors suggest that this could have implications for when physiotherapy should be commenced and that this could be an argument for delaying the rehabilitation process following rotator cuff repair surgery.

Critique

This paper aimed to monitor the behaviour of the rotator cuff after repair and to establish at what point failure may occur following repair. They used a technique (RSA) which they had previously validated.

Strengths
This was a well designed study on a subject of significant clinical interest.
Well defined inclusion criteria were used.

RSA is an established technique in other areas of orthopaedics which the senior authors had previously validated for this use in assessing the rotator cuff.
Regular well defined points were identified at which the measurements were taken.
Attempts were made to make all measurements as uniform as possible by using an abduction splint with the patient supine for all RSA measurements.

Methodological concerns

Insufficient data was provided in the paper regarding the size of the cuff tears that didn't fail but either remained intact or partially tore and the size of the partial re-tears and the correlation of this data to the specific patients. We also feel that details about the quality of the cuff at the time of surgery and the quality of the repair at the time of surgery would have been valuable to include in each case, as these would have an important impact on outcome and the risk of failure of the repair.

Various factors related to the timing at which the RSA measurements were taken could have introduced inconsistencies in the methodology as follows;
The use of an interscalene block with the general anaesthetic would have meant that at the time of the initial assessment at 1 hour following surgery the supraspinatus would be temporarily denervated. Consequently the 'normal' tone of the rotator cuff would be absent and the position of the markers in the supraspinatus tendon in this state would not equate to subsequent readings in which the cuff would be neurologically active under tension.
Equally, when assessed on day 3 post op the effects of the nerve block would have worn off but the resulting pain would result in a 'protective' spasm or abnormal tension within the rotator cuff muscles which may also not reflect the 'normal' tone of the rotator cuff and similarly affect the resulting position of the RSA markers.

It may have been better to co-ordinate the RSA data measurements with the times at which changes in the rehab programme were initiated (eg changing from immobilsation in the abduction splint to assisted passive flexion and abduction at 4 weeks and again at 10 weeks when changing from assisted passive flexion and abduction to full active movements).

The results reported in this series reveal a high complication rate with only 50% of the repairs found to be intact at 1 year.
One of the 10 patients developed a severe CRPS and had not regained any useful shoulder function by the end of the study. It would have been useful to know if this patient was in the group of patients who had an intact repair at 1 year or if he had had a partial re-tear or complete re-tear.

The fraying of the markers within the cuff in 3 of the 10 patients over the course of the year would need to be addressed before using this technique for any further studies and the authors recognise this.

We recognise that the rehabilitation following rotator cuff repair varies between surgeons and between units. In our unit we routinely use a more rapid mobilisation programme following rotator cuff repair. Certainly we feel that any suggestions to immobilise the shoulder even longer based on the results of this study is unnecessary and may not be a valid conclusion to draw from this study.

In summary this paper is an interesting study looking at the behaviour of the rotator cuff following cuff repair. It does have some methodological weaknesses that limit some of the conclusions that can be drawn from it particularly if wishing to use this paper to guide rehabilitation protocols following rotator cuff repair surgery.