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# Progression of Symptomatic Partial-Thickness Rotator Cuff Tears

## - Association With Initial Tear Involvement and Work Level -

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Objectives : There is no clear consensus on progression rate of PTRCT. This study aimed to identify the risk factors associated with tear progression of PTRCT.

Results : The mean MRI follow-up period was 22.3 ± 17.2 months (median, 16.1 months; range, 6.4-89.5 months), and tear progression was observed in 12 patients (13.5%). In these 12 patients, tear involvement increased by 60% of the rotator cuff footprint, while mediolateral (ML) and anteroposterior (AP) tear sizes progressed by 1.1 and 1.8 mm, respectively. Univariate regression analysis showed that shoulder stiffness (P ¼ .031), work level (P ¼ .001), initial tear involvement (P < .001), ML and AP tear sizes (P < .001 and P ¼ .005, respectively), and acromion type (P ¼ .003) were significantly associated with tear progression.

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<Mandatory disclosure>

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## Materials & Method

- Total 89 patients
- From Aug 2012 to Aug 2019
- Patients with MRI diagnosis of PTRCT

## Clinical evaluation

- **Pain level, Stiffness**

## Radiologic evaluation

- **CSA, LAA, AS, AHI, Acromion type** (X-ray)
- **ML & AP tear size** (MRI)

* Overall Patient Characteristics and Radiologic Parameters (N = 89 Patients)

| Variable | | Value |
|---|---|---|
| Age (years) | | 55.9 ± 9.6 |
| Sex (male/female) | | 26/63 |
| Side (right/left) | | 66/23 |
| Symptom duration (months) | | 25.7 ± 33.5 |
| BMI | | 23.7 ± 3.0 |
| Comorbidities | DM (controlled/uncontrolled) | 6/3 |
| | Hypercholesterolemia | 8 |
| Smoking status (none/current/former) | | 75/10/4 |
| Alcohol use (none/light/heavy) | | 72/14/3 |
| Trauma history | | 17 |
| Stiffness | | 21 |
| Work level (low/medium/high) | | 28/48/13 |
| Time to follow-up MRI (months) | | 22.3 ± 17.2 |
| Articular/bursal tear | | 60/29 |
| Subscapularis tear (intact/partial) | | 70/19 |
| Acromion type (flat/curved/hooked/heel) | | 12/66/8/3 |
| Radiologic parameters | CSA (degree) | 33.5 ± 3.5 |
| | LAA (degree) | 75.1 ± 11.5 |
| | AS (degree) | 28.0 ± 8.9 |
| | AHI (mm) | 8.9 ± 1.5 |

* AHI, acromiohumeral interval; AS, acromial slope; BMI, body mass index; CSA, critical shoulder angle; DM, diabetes mellitus; LAA, lateral acromial angle;

# Results

- Mean MRI follow-up period was **22.3 ± 17.2 months**
- Tear progression was observed in **12 patients (13.5%).**

* Overall Results, Natural History of PTRCT

| Overall | | Initial MRI | Follow-up MRI | P value |
|---|---|---|---|---|
| Tear involvement (%) | | 28.2 ± 28.1 | 38.4 ± 48.5 | **.001** |
| ML tear size (mm) | | 3.9 ± 4.4 | 4.6 ± 5.0 | **.017** |
| AP tear size (mm) | | 5.1 ± 4.1 | 5.5 ± 4.8 | .413 |
| Fatty infiltration | Subscapularis | 0.9 ± 0.5 | 0.9 ± 0.5 | .320 |
| | Supraspinatus | 0.9 ± 0.4 | 0.9 ± 0.4 | .369 |
| | Infraspinatus | 0.8 ± 0.4 | 0.9 ± 0.3 | **.020** |
| | Teres minor | 0.9 ± 0.4 | 0.9 ± 0.3 | .181 |

- Univariate regression analysis showed that **shoulder stiffness** (P = .031), **work level** (P = .001), **initial tear involvement** (P < .001), **ML and AP tear sizes** (P < .001 and P = .005, respectively), and **acromion type** (P = .003) were significantly associated with tear progression.

* Comparison of Patient Factors According to Tear Progression at Follow-up

| Univariate Analysis | | Tear Progression (n = 12) | No Tear Progression (n = 77) | P value |
|---|---|---|---|---|
| Age (years) | | 55.7 ± 9.7 | 56.8 ± 8.6 | .709 |
| Sex (male/female) | | 3/9 | 23/54 | .730 |
| Side (right/left) | | 7/5 | 59/18 | .178 |
| Symptom duration (months) | | 25.3 ± 35.1 | 25.8 ± 33.5 | .965 |
| BMI | | 25.9 ± 2.2 | 23.4 ± 2.9 | .081 |
| Comobidities | DM (controlled/uncontrolled | 1/1 | 5/2 | .323 |
| | Hypercholesterolemia | 0 | 8 | >.999 |
| Smoking status (none/light/heavy) | | 2/9/1 | 8/66/3 | .387 |
| Alcohol use (none/light/heavy) | | 9/3/0 | 63/11/3 | .616 |
| Trauma history | | 3 | 14 | .624 |
| Stiffness (n, (%)) | | 6 (50) | 15 (19) | **.031** |
| Work level (low/medium/high, n, (%)) | | 5 (42)/ 1 (8) / 6 (50) | 23 (30) / 47 (61) / 7 (9) | **.001** |
| Time to follow-up MRI (months) | | 20.3 ± 11.4 | 22.6 ± 17.8 | .670 |
| Shoulder pain status | Improved | 1 | 4 | |
| | Similar | 4 | 29 | .906 |
| | Aggravated | 7 | 41 | |

* Comparison of Radiologic Factors According to Tear Progression

| Univariate Analysis | | Tear Progression (n = 12) | No Tear Progression (n = 77) | P value |
|---|---|---|---|---|
| Initial tear involvement (%) | | 67.2 ± 28.3 | 22.5 ± 23.2 | **<.001** |
| Initial tear size (mm) | ML | 9.8 ± 6.8 | 3.0 ± 3.1 | **<.001** |
| | AL | 9.1 ± 5.2 | 4.2 ± 3.4 | **.005** |
| Follow-up tear involvement (%) | | 126.0 ± 70.0 | 24.5 ± 23.5 | **<.001** |
| Follow-up tear size (mm) | ML | 10.9 ± 5.9 | 3.7 ± 4.0 | **<.001** |
| | AP | 10.9 ± 3.9 | 4.2 ± 3.4 | **<.001** |
| Radiologic parameters | CSA (degree) | 75.1 ± 3.6 | 33.3 ± 3.5 | .107 |
| | LAA (degree) | 79.4 ±11.2 | 74.4 ± 11.5 | .166 |
| | AS (degree) | 33.2 ±10.1 | 27.2 ± 8.5 | .070 |
| | AHI (mm) | 9.1 ± 2.2 | 8.9 ± 1.4 | .563 |
| Acromion type (n, (%)) | Flat | 5 (41.7) | 7 (9.1) | **.003** |
| | Curved | 4 (33.3) | 62 (80.5) | |
| | Hooked | 1 (8.3) | 7 (9.1) | |
| | Heel | 2 (16.7) | 1 (1.3) | |
| Articular/bursal tear | | 11/1 | 49/28 | .094 |
| Subscapularis tear (intact/partial) | | 11/1 | 59/18 | .237 |
| Initial fatty infiltration | Subscapularis | 0.9 ± 0.8 | 0.9 ± 0.4 | .946 |
| | Supraspinatus | 0.8 ± 0.6 | 0.9 ± 0.3 | .779 |
| | Infraspinatus | 0.8 ± 0.5 | 0.8 ± 0.4 | .483 |
| | Teres minor | 0.9 ±0.3 | 0.7 ± 0.5 | .171 |
| Follow-up fatty infiltration | Subscapularis | 1.0 ± 0.7 | 0.9 ± 0.4 | .665 |
| | Supraspinatus | 0.8 ± 0.6 | 0.9 ± 0.4 | .665 |
| | Infraspinatus | 0.9 ± 0.3 | 0.9 ± 0.4 | .976 |
| | Teres minor | 0.9 ± 0.3 | 0.8 ± 0.5 | .267 |

## Results

- Multivariate regression analysis showed that **initial tear involvement** (odds ratio[OR], 1.053; 95% CI, 1.006-1.102; P = .026) and **high work level** (OR, 15.831; 95% CI, 1.150-217.856; P = .039) were independent risk factors for tear progression. The cutoff value for initial tear involvement was 47.5% (sensitivity, 81.8%; specificity, 85.7%).

* Independent Risk Factors for PTRCT Progression

| Multivariate Analysis | | OR (95% CI) | P value |
|---|---|---|---|
| Stiffness | | 0.610 (0.101-3.676) | .590 |
| Work level | Medium | - | .996 |
| | High | 15.831(1.150-217.856) | **.039** |
| Initial tear involvement | | 1.053 (1.006-1.102) | **.026** |
| Initial AP tear size | | 1.015 (0.754-1.367) | .920 |
| Acromion type | Curved | - | .996 |
| | Hooked | - | .997 |
| | Heel | 20.054 (0.611-658-537) | .092 |

## Conclusion

- Tear progression was observed in **14%** of patients with PTRCT in this study. To predict tear progression, evaluating the tear involvement during initial MRI is essential. The risk of tear progression increased with **initial tear involvement >47.5%** and a **heavy work level**.

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