Prestyloid recess of the wrist: normal appearance on 3T MR arthrography using 3D DESS sequence.

Poster No.: P-0057
Congress: ESSR 2013
Type: Scientific Exhibit
Authors: S. Döring¹, S. Bal², S. Corstjens¹, E. Cattrysse¹, P. Van Roy¹, M. Shahabpour¹, ¹Brussels/BE, ²Brussel/BE
Keywords: Pathology, Arthrography, MR, Musculoskeletal joint, Extremities, Anatomy
DOI: 10.1594/essr2013/P-0057

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Purpose

The purpose of this study was:

1) To measure the different morphometric aspects of the prestyloid process (PSR)
   a) Length up to the carpus
   b) Length up to the PSR opening
   c) Width of the PSR opening
   d) Width of the maximum bulge of the PSR
   e) Antero-posterior diameter

2) To study the different anatomic features of the PSR
   a) Shape
   b) Position
   c) Configuration in relation to the meniscus homologue

3) To assess the inter- and intra-observer reliability of the study

Background

Several authors describe PSR as a component of the triangular fibrocartilage complex (TFCC) [1-7]. Since TFCC can be involved in traumatic and degenerative wrists, detailed anatomic knowledge of all its components could help in the assessment and management of wrist joint pathologies.

TFCC is a ligamentous and fibro-cartilaginous structure with radius and ulna on one side and the lunate and triquetrum on the other side. It is an important stabilizer of the distal radio-ulnar joint.
Methods and Materials

102 wrist MR arthrography examinations from the UZ Brussel MR database were reviewed and 34 of these were included in the study based on the following inclusion and exclusion criteria:

**Inclusion criteria:**
- Age between 18 and 50 years
- MR imaging not > four years older
- Intact TFCC with the presence of the surrounding structures such as the ulna, the radius and the carpal bones

**Exclusion criteria:**
- Pathologic TFCC (main reason for exclusion)
- Positive / Negative ulnar variance
- PSR not clearly definable
- Insufficient contrast on the ulnar side of wrist

MR imaging was performed with wrist in neutral position using 8-channel phased array coil on 3T MR.

**3D DESS** (dual echo steady state precession) sequence (TR/TE - 10/7, sl thickness - 0.5mm, flip angle 30, matrix size - 188 x 218, FOV 85 x 98 x 50) was obtained to provide **isotropic images** (pixel size 0.35 x 0.35 x 0.35).

3D DESS sequences give submillimetric sections with high spatial resolution, which allows better visualization of the small intra-articular structures [8,9].

Two observers analyzed the MR images separately and independently from each other. All the images were completely evaluated by each observer (series 1) and then the same images were once again evaluated by the two observers (series 2) with a minimum gap of one week between the two series.
Results

PSR, an extension of the radioulnar joint, is a fluid filled space lined with synovium [2]. The meniscus homologue surrounds the opening of the PSR [10].

Anatomic features:

A) **Shape**: PSR shape was classified into saccular (commonest - 64% to 71.5%) (Fig.1), tubular, cone-shaped (Fig.2) and tongue-shaped (Fig.3).

Table 1: shows different shapes of PSR as detected by the two observers. Saccular shape was found to be the commonest shape.

<table>
<thead>
<tr>
<th>Shape</th>
<th>Observer 1.1</th>
<th>Observer 1.2</th>
<th>Observer 2.1</th>
<th>Observer 2.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saccular</td>
<td>67.9%</td>
<td>71.4%</td>
<td>71.4%</td>
<td>64.3%</td>
</tr>
<tr>
<td>Tubular</td>
<td>7.1%</td>
<td>10.7%</td>
<td>7.1%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Cone-shaped</td>
<td>10.7%</td>
<td>17.9%</td>
<td>7.1%</td>
<td>14.3%</td>
</tr>
<tr>
<td>Tongue-shaped</td>
<td>14.3%</td>
<td>0%</td>
<td>14.3%</td>
<td>17.9%</td>
</tr>
</tbody>
</table>

B) **Configuration**: Configuration of PSR was determined in relation to meniscus homologue and classified as wide opening, narrow opening (Fig.4) and no opening (Fig.5).

Table 2: shows the three configurations of the PSR. Narrow opening configuration had the highest percentage.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Observer 1.1</th>
<th>Observer 1.2</th>
<th>Observer 2.1</th>
<th>Observer 2.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow opening</td>
<td>67.6%</td>
<td>64.7%</td>
<td>52.9%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Wide opening</td>
<td>17.6%</td>
<td>17.6%</td>
<td>29.4%</td>
<td>32.4%</td>
</tr>
<tr>
<td>No opening</td>
<td>17.7%</td>
<td>17.6%</td>
<td>17.6%</td>
<td>17.6%</td>
</tr>
</tbody>
</table>

C) **Position**: in relation to the styloid process could be palmar (Fig.6), radiopalmar, ulnopalmar and apical.
Table 3: shows the different positions of PSR in relation to the ulnar styloid process. Both observers found the palmar position to be the commonest.

<table>
<thead>
<tr>
<th>Position</th>
<th>Observer 1.1</th>
<th>Observer 1.2</th>
<th>Observer 2.1</th>
<th>Observer 2.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palmar</td>
<td>92.6%</td>
<td>88.5%</td>
<td>73.1%</td>
<td>72%</td>
</tr>
<tr>
<td>Radiopalmar</td>
<td>3.7%</td>
<td>7.7%</td>
<td>3.8%</td>
<td>4%</td>
</tr>
<tr>
<td>Ulnopalmar</td>
<td>3.7%</td>
<td>3.8%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Apical</td>
<td>0%</td>
<td>0%</td>
<td>23.1%</td>
<td>24%</td>
</tr>
</tbody>
</table>

Morphometric measurements:

The following measurements of PSR were performed.

a) Length up to the carpus (Fig.7)

b) Length up to the opening of PSR (Fig.8)

c) Width of the opening (Fig.9)

d) Width of the bulge (Fig.10)

e) Anteroposterior diameter (Fig.11)

Table 4: gives a summary of the different measurements performed on the PSR by the two observers. All measurements are in millimeters.

<table>
<thead>
<tr>
<th>Length</th>
<th>Length</th>
<th>Width</th>
<th>Width</th>
<th>AP diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>carpus</td>
<td>opening</td>
<td>bulge</td>
<td>opening</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>F</td>
<td>M</td>
<td>F</td>
<td>M</td>
</tr>
<tr>
<td>Mean</td>
<td>10.27</td>
<td>8.47</td>
<td>7.50</td>
<td>5.90</td>
</tr>
<tr>
<td>Med</td>
<td>10.22</td>
<td>8.97</td>
<td>7.20</td>
<td>6.05</td>
</tr>
<tr>
<td>Mode</td>
<td>6.68</td>
<td>5.85</td>
<td>8.10</td>
<td>3.65</td>
</tr>
<tr>
<td>SD</td>
<td>1.98</td>
<td>1.73</td>
<td>1.82</td>
<td>1.36</td>
</tr>
<tr>
<td>Var</td>
<td>3.95</td>
<td>3.01</td>
<td>3.33</td>
<td>1.85</td>
</tr>
<tr>
<td>Range</td>
<td>8.13</td>
<td>4.65</td>
<td>7.18</td>
<td>3.65</td>
</tr>
</tbody>
</table>
Inter-observer and intra-observer reliability:

Table 5 shows the inter- and intra-observer reliability of this study. Note that there is a better inter- and intra-observer correlation for the different measurements of the PSR than for the anatomic features, because measurements are objective assessments and are more precise, whereas anatomic features are more variable due to subjective nature of the analysis.

<table>
<thead>
<tr>
<th>Reliability</th>
<th>Intra-observer Series 1</th>
<th>Intra-observer Series 2</th>
<th>Inter-observer Series 1</th>
<th>Inter-observer Series 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length-carpus</td>
<td>0.908</td>
<td>0.801</td>
<td>0.958</td>
<td>0.772</td>
</tr>
<tr>
<td>Length-opening</td>
<td>0.875</td>
<td>0.826</td>
<td>0.768</td>
<td>0.736</td>
</tr>
<tr>
<td>AP diameter</td>
<td>0.902</td>
<td>0.800</td>
<td>0.899</td>
<td>0.825</td>
</tr>
<tr>
<td>Width-opening</td>
<td>0.834</td>
<td>0.707</td>
<td>0.786</td>
<td>0.542</td>
</tr>
<tr>
<td>Breadth-bulge</td>
<td>0.840</td>
<td>0.635</td>
<td>0.830</td>
<td>0.681</td>
</tr>
<tr>
<td>Shape</td>
<td>0.708</td>
<td>0.503</td>
<td>0.333</td>
<td>0.441</td>
</tr>
<tr>
<td>Configuration</td>
<td>0.825</td>
<td>0.855</td>
<td>0.635</td>
<td>0.450</td>
</tr>
<tr>
<td>Position</td>
<td>0.355</td>
<td>0.242</td>
<td>0.288</td>
<td>0.119</td>
</tr>
</tbody>
</table>

The presence of a connection between the prestyloid recess and the pisotriquetral joint was observed [11] (Fig. 12).

Salient features of this study are that it is the first (to the best of our knowledge) detailed and precise in vivo study of the PSR in a young human population. The previous studies were less detailed and have been performed on cadavers [6,12].
Fig. 1: 0.5mm thick sections in coronal plane with 3D DESS sequence in a 30 year old man shows a saccular PSR (black asterisk). Dotted arrow = articular disc, uninterrupted arrow= meniscus homologue, U= ulna, R= radius, T= os triquetrum, L= os lunatum.

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**Fig. 4:** 0.5mm thick section in coronal plane with 3D DESS sequence shows a PSR (black asterisk) with a narrow opening configuration in relation to the meniscus homologue. U = ulna, R = radius, T = os triquetrum, L = os lunatum.

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Fig. 5: 0.5mm thick section in coronal plane with 3D DESS sequence shows a PSR configuration without an opening. U= ulna, R= radius, T= os triquetrum, L= os lunatum.

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**Fig. 11:** 3D DESS sequence with axial 0.5 mm reconstructions in a 38 years old man shows palmar position of the PSR in relation to the ulnar styloid process (red arrow).

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Fig. 6: 0.5mm thick sections in coronal plane, with 3D DESS sequence in a 38 year old man - Length of the PSR up to the carpus.

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**Fig. 9:** 0.5mm thick sections in coronal plane with 3D DESS sequence in a 38 year old man - Width of the PSR bulge.

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**Fig. 10:** Axial reconstruction of 0.5mm thick sections with 3D DESS sequence - Anteroposterior diameter of the bulge.

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**Fig. 8:** 0.5mm thick sections in coronal plane with 3D DESS sequence in a 38 year old man - Width of the PSR opening.

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**Fig. 7:** 0.5mm thick sections in coronal plane with 3D DESS sequence in a 38 year old man - Length of the PSR up to the opening.

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Fig. 12: 3D DESS sequence with axial 0.5 mm reconstructions shows the connection (red arrow) between PSR (black asterisk) and the pisotriquetral joint (black arrow).
Fig. 2: 0.5mm thick section in coronal plane with 3D DESS sequence in a 41 years old man shows a cone shaped PSR (black asterisk) with a wide opening. U= ulna, R= radius, T= os triquetrum, L= os lunatum.

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**Fig. 3:** 0.5mm thick section in coronal plane with 3D DESS sequence in a 34 years old man. A tongue-shaped PSR (black asterisk) with a narrow opening is seen. U= ulna, R= radius, T= os triquetrum, L= os lunatum.

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Conclusion

MRA using 3D DESS sequence is useful for detailed study of PSR. Various measurements of the PSR could be performed and its anatomic features could be analysed. The commonest shape, configuration and position could be determined. The inter-observer and intra-observer reliability for the various measurements of PSR is higher than that for the anatomic features. A connection between the PSR and the pisotriquetral joint was observed.
References