Radiological analysis and comparison of the shape of the base of the first metacarpal in the young subject and the subject with osteoarthritis.

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CONFLICTS OF INTEREST

- Research support/Scientific studies: NO
- Consultancy, Expert: NO
- Trainings, Teaching: NO
- Advertising documents: NO
- Invitation to national or international congresses: NO
- Stock shareholder: NO
- Patent or product inventor: NO
Loss of height of M1
Arthritis of anterior part of the basis
The aim of the study

Can we observe radiological differences between young asymptomatic and old symptomatic patients?
Material and methods

- Retrospective study with a control group
  - Group TMO 50 patients (symptomatological osteoarthritis and pre-op X-ray)
  - Control Group 70 patients (aged 18 to 45 and X-ray taken in the emergency room)

- Analysis of thumb radiographs by author with MicroDicom Viewer® software
  - Face X-ray with the first two metacarpals
  - Profile X-ray with superposition of sesamoïde > 50%

- Collected data
  - Age at the X-ray
  - Sexe
Radiological analysis

1. Measurement of the angle between the two most proximal points of the base and the posterior cortex of the diaphysis of the first metacarpal
Radiological analysis

1. Measurement of the angle between the two most proximal points of the base and the posterior cortex of the diaphysis of the first metacarpal

2. A ratio between the smallest width of the diaphysis and the width of the base of the first metacarpal defined by the two most proximal points forming the edges of the joint

   \[ \text{Ratio} = \frac{\text{Diaphysis Width}}{\text{Base Width}} \]
3. A measure of the circularity of the articular surface in profile, measured using the highest point of the articular surface with respect to the line connecting the two ends of the articular surface of the base

Circularity = height / Base width
4. A ratio $\frac{M1}{M2}$ measuring the trapezio-metacarpal height compared to the trapezoidal-metacarpal height on a frontal image.

$$M1/M2 \approx 0.73$$
Radiological analysis

5. Classification of Eaton and Littler

Trapeziometacarpal osteoarthritis: staging as a rationale for treatment.
Results

- Trapezo-metacarpal osteoarthritis group
  - 50 patients: 43 women and 7 men
  - Average age 61.9 (SD 8.7)

- Control Group
  - 70 patients: 33 women and 37 men
  - Average age 29.7 (SD 8.8)
  - Eaton Raking: no harm 63, Eaton 1: 7
1. Measurement of the base / diaphysis angle of the 1st metacarpal

2. Significant difference between the two groups

<table>
<thead>
<tr>
<th>Values</th>
<th>TMO Group</th>
<th>Control Group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Average Angle</td>
<td>72,6°</td>
<td>80,6°</td>
<td>P &lt;0,001</td>
</tr>
<tr>
<td>Average Angle ♀</td>
<td>73,1° (n=43)</td>
<td>81,4° (n=33)</td>
<td>P &lt;0,001</td>
</tr>
<tr>
<td>Average Angle ♂</td>
<td>69,5° (n=7)</td>
<td>79,8° (n=37)</td>
<td>P &lt;0,001</td>
</tr>
</tbody>
</table>
Results

2. Ratio between the width of the diaphysis and the width of the base
   - There is a decrease in the ratio in the TMO group
   - Significant difference between the two groups

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<th>Control Group</th>
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<tbody>
<tr>
<td>Group average ratio</td>
<td>0.64</td>
<td>0.76</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Average ratio♀</td>
<td>0.63 (n=43)</td>
<td>0.76 (n=33)</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Average ratio♂</td>
<td>0.66 (n=7)</td>
<td>0.76 (n=37)</td>
<td>p = 0.002</td>
</tr>
</tbody>
</table>
3. Circularity measurement

- The closer this number is to 1, the smaller the curvature $R$, a number close to 0 will have a very large $R$ of curvature and a number equal to 0 will mean that all points are on the same line.

- Significant difference between the two groups

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<th>Control Group</th>
<th>P value</th>
</tr>
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<tbody>
<tr>
<td>Group Average Circularity</td>
<td>0.09</td>
<td>0.13</td>
<td>P &lt;0.0005</td>
</tr>
<tr>
<td>Average Circularity ♀</td>
<td>0.09 (n=43)</td>
<td>0.13 (n=33)</td>
<td>P = 0.006</td>
</tr>
</tbody>
</table>
Circularity measurement
Results

4. Ratio M1/M2

- There is a decrease in the ratio in the TMO group indicating a decrease in the height of the thumb column

- Significant difference between the two groups

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<th>Control Group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group average ratio</td>
<td>0.703</td>
<td>0.737</td>
<td>P &lt;0.001</td>
</tr>
<tr>
<td>Average ratio♀</td>
<td>0.701 (n=43)</td>
<td>0.733 (n=33)</td>
<td>P = 0.008</td>
</tr>
<tr>
<td>Average ratio♂</td>
<td>0.717 (n=7)</td>
<td>0.741 (n=37)</td>
<td>P = 0.048</td>
</tr>
</tbody>
</table>
Results

Correlation analysis according to Eaton's rank
Results

Correlation analysis according to Eaton's rank
Results

Correlation analysis according to the angle base/diaphyse
Discussion

Trapezo-metacarpal osteoarthritis would lead to:

A decrease in the angle between the base and the diaphysis of the 1st metacarpal by progressive wear of the beak

This wear would bring to

- A decrease in the height of the thumb column
- An enlargement of the base of the 1st metacarpal by osteophyte remodeling
- A decrease in circularity by erasing the anterior beak
Discussion

Why is there a widening of the base?

Osteoarthritic rearrangements causing osteophytic appositions have already been observed in other joints (the internal tibial plateau during Varus deformations, for example)

- The high bone density observed in the dorsal and radial quadrant could reflect this bone impaction

- Another possibility would be a decrease in the diameter of the diaphysis with time, an unlikely element since osteoporosis leads to a decrease in cortical thickness and a reaction increase in diameter.
Discussion

Why is there a decrease in the height of the thumb column between the two groups?

The fall in the ratio M1 / M2 has several possible causes:

- Dorsal and radial subluxation of the base of the 1st metacarpal
- A loss of trapezoid height
- The disappearance of the cartilaginous surface

This reproducible measurement can already be used in the clinic for restoring the height of the thumb column.
Conclusion

- Retrospective study on two groups of patients
- Angle measurements, circularity and base / diaphysis ratio are not described in the literature
- Measurable measurements on standard X-ray and showing significant differences
- Patients suffering from a clinical TMO have an erasing of the first metacarpal beak associated with:
  - A decrease in circularity
  - A loss of height of the column of the thumb
  - An enlargement of the base
- Preliminary study opens the door to a wider study including older asymptomatic subjects