What is the Evidence to Support Acetabular Dysplasia as Cause of Osteoarthritis?

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Acetabular Dysplasia

In otherwise normal individuals

CP
Myelodysplasia
Arthropathies
etc.
Osteoarthritis

Prior to 65 y/o
We will look at-

**Five** studies

that provide evidence

about the relationship between

acetabular dysplasia and osteoarthritis
Data and Concepts

Wiberg G. 1939
Cooperman DR, et al. 1983
Murphy SB, et al. 1995
Jacobsen S, et al. 2005
Kosvig KK, et al. 2010
In 1939, Wiberg acetabular dysplasia precipitates osteoarthritis pressure concentration.
He suggested a measurement

\[ \Theta = \text{Center Edge (C.E.) Angle of Wiberg} \]
Wiberg control x-rays

50 functionally normal men
50 functionally normal women

Between 20 y/o and 35 y/o

(200 hips)
Wiberg controls

No CE angle

was under $20^0$
abnormal

marginal

Wiberg 200 controls

CE angle

20 to 25
26 to 30
31 to 35
36 to 40
41 to 45
over 45

44 adults

CE angles under 20°

no signs of osteoarthritis

He followed

18 of the 44 adults

from 4 to 29 years
They all developed Osteoarthritis
<table>
<thead>
<tr>
<th>Osteoarthritis first noted</th>
<th>Average CE angle</th>
<th>Range</th>
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<tbody>
<tr>
<td>4th decade</td>
<td>2°</td>
<td>(neg. to 5°)</td>
</tr>
<tr>
<td>5th decade</td>
<td>5°</td>
<td>(neg. to 12°)</td>
</tr>
<tr>
<td>6th decade</td>
<td>10°</td>
<td>(8° to 15°)</td>
</tr>
<tr>
<td>7th decade</td>
<td>12°</td>
<td>(7° to 17°)</td>
</tr>
<tr>
<td>8th decade</td>
<td>18°</td>
<td></td>
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</table>
Wiberg illustrated all of the 18 cases he followed.
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small CE angle = high risk of subluxation
7 of the 19 hips were subluxated

All were arthritic by 42 y/o
Wiberg’s data suggests-

Subluxation leads to rapid OA
Wiberg’s concept is powerful
Can you imagine a subluxated hip doing well in late adulthood?
Can you imagine a palm tree doing well at the North Pole?
Stable Dysplastic hips

Wiberg’s hips

12 of 19 hips had Shenton’s line intact

Age at which osteoarthritis supervened was quite variable
Stable hip dysplasia

a. Intact Shenton’s line

b. CE angle $< 20^0$
Cooperman et al, CORR 1983

Identified 32 stable, dysplastic hips (20 adults)

None had arthritis

Average age 43 years (range 27-57 y/o)
We measured four markers for acetabular dysplasia.
After 22 years, all had arthritis.
No linear relationship between the four markers and the age of onset of osteoarthritis.
I 1. Randomized controlled trial  
   2. Systematic review of randomized controlled trials.

II 1. Prospective cohort study  
   2. Poor-quality randomized controlled trial (<80% follow-up)

III 1. Case-controlled study  
   2. Retrospective cohort study  
   3. Systematic review of Level III studies

IV Case series

V Expert Opinion
Murphy, Ganz, Mueller JBJS 1995

Reviewed 286 patients unilateral total hip arthroplasty
“clearly secondary to dysplasia of the hip.”

They characterized the opposite hips-
Of the 286 “opposite hips”

115 developed severe osteoarthritis

46 reached 65 y/o without severe arthritis

(125 were less than 65 y/o without severe arthritis)
43 hips over 65 y/o
without Severe OA
Murphy, Ganz, Mueller JBJS 1995

43 hips over 65 y/o
without Severe OA

CE angle $34^0 +/-. 9^0$ (range $16^0$ to $49^0$)
Jacobsen et al, Acta Orthopaedica 2005

Looked at 4,151 adults randomly selected
All had hip x-rays

Average age 61 y/o (range 22 to 93 y/o)

Shenton’s line intact in all cases
They measured all the hips on a standing AP pelvis.

Figure 1a. The CE angle of Wiberg.

Figure 1b. Sharp's angle.

Figure 1c. The femoral head extrusion index (FHEI).

Figure 1d. The acetabular depth ratio (ADR).
Factors relating to joint space narrowing

1. Age
2. BMI
3. Four measures of dysplasia,
4. Different levels of occupational exposure to daily repeated lifting
5. Pack-years of smoking
Excluded

1. Previous hip surgery (except THA)
2. Previous hip fracture
3. Treatment for childhood hip disease
4. Inflammatory arthropathy in any joint.
Figure 2b. Distribution of left hip CE angles.

Jacobsen 7,718 hips

Wiberg controls 200 hips
3.4% (260 hips) CE angles under $20^0$
3.4% (260 hips)
CE angles under $20^0$
3.4% (260 hips)
CE angles under $20^0$

None under $5^0$
Jacobsen
Arthritis = joint space narrowing

Men- hip dysplasia (CE angle < 20°)

Women- hip dysplasia (CE angle < 20°) and age

Arthritis unrelated to-
BMI, lifting at work, smoking
acetabular depth or the extrusion index
Figure 4. Moderate hip dysplasia without radiological signs of osteoarthritis. A: male, 65 years, left hip; CE = 16°. B: female, 52 years, left hip; CE = 15°. C: female, 65 years, left hip; CE = 17°. D: male, 60 years, left hip; CE = 15°.
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Gosvig et al, JBJS 2010

Looked at 4,151 adults randomly selected
All had hip x-rays

Shenton’s line intact in all cases
Same x-rays as Jacobsen, a co-author
1. Acetabular dysplasia

2. a deep acetabulum (CE angle > 45°)

3. a pistol-grip deformity

4. a deep acetabulum and a pistol-grip deformity
Excluded cases with

- Total hip arthroplasty (n = 71)
- Legg-Calve-Perthes disease (n = 25)
- Childhood hip disease (n = 32)
- Rheumatoid arthritis (n = 141)
- Unreadable x-rays (n = 168)
- Excessive rotation (n = 94)
We found that a pistol grip malformation and a deep acetabular socket were significant risk factors for hip osteoarthritis. Acetabular dysplasia and the subject’s sex were not found to be significant risk factors.
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Confusion and Exclusions

Jacobsen 2005
1,429 men
2,430 women

97
142

AD leads to OA

Gosvig 2010
1,332 men
2,288 women

AD doesn’t lead to OA
A cautionary tale

Dueling Level II Studies VS
Acetabular Dysplasia

When is acetabular dysplasia severe enough to precipitate osteoarthritis in 100% of otherwise normal individuals in early adulthood?
Acetabular Dysplasia

When is acetabular dysplasia severe enough to precipitate osteoarthritis in 100% of otherwise normal individuals in early adulthood?

Subluxation
Acetabular Dysplasia

When is acetabular dysplasia severe enough to precipitate osteoarthritis in 100% of otherwise normal individuals prior to 65 y/o and probably much sooner?

CE angle under $5^0$
Acetabular Dysplasia

When is acetabular dysplasia severe enough to precipitate osteoarthritis in 100% of otherwise normal individuals prior to 65 y/o, with a very unpredictable time of presentation?

CE angle between $6^0$ and $15^0$
Acetabular Dysplasia

With a CE angle between $15^0$ to $19^0$, OA will probably supervene prior to 65 y/o, but it is not a certainty.
Factors that may affect hip integrity

1. Native toughness of cartilage
2. Age
3. Gender
4. Obesity
5. Ligamentous Stability
6. Occupation
7. Recreation
8. Femoral Deformity
The value of a case

65 y/o male
CE 16°

- Probable
- Improbable
**Possible**
Acetabular Dysplasia as a function of the CE angle measured at skeletal maturity

- **Very early OA**
  - Subluxation

- **Early OA**
  - CE angle $< 5^0$

- **OA before 65 y/o**
  - CE angle $6^0$ to $15^0$

- **Usually develops OA**
  - CE angle $16^0$ to $19^0$
Acetabular Dysplasia

Predictions using advanced techniques may provide better prognostic information than the CE angle.


