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My Aching Knees

Detection and Prevention

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Osteoarthritis

Osteoarthritis (OA) is the most frequent joint disease

↓

In the U.S. about 27 million suffer from symptomatic osteoarthritis[1]

↓

Affects nearly 50% of patients 75 years and older[2]

↓

- results in **long-term disability**
- enormous economical health care cost burden[3]

[1] Lawrence et al. Arthritis and rheumatism 2008
[2] Litwic et al. Br Med Bull. 2013
[3] Kotlarz et al. Arthritis and rheumatism 2009; Illustration from www.healthcare.utah.edu

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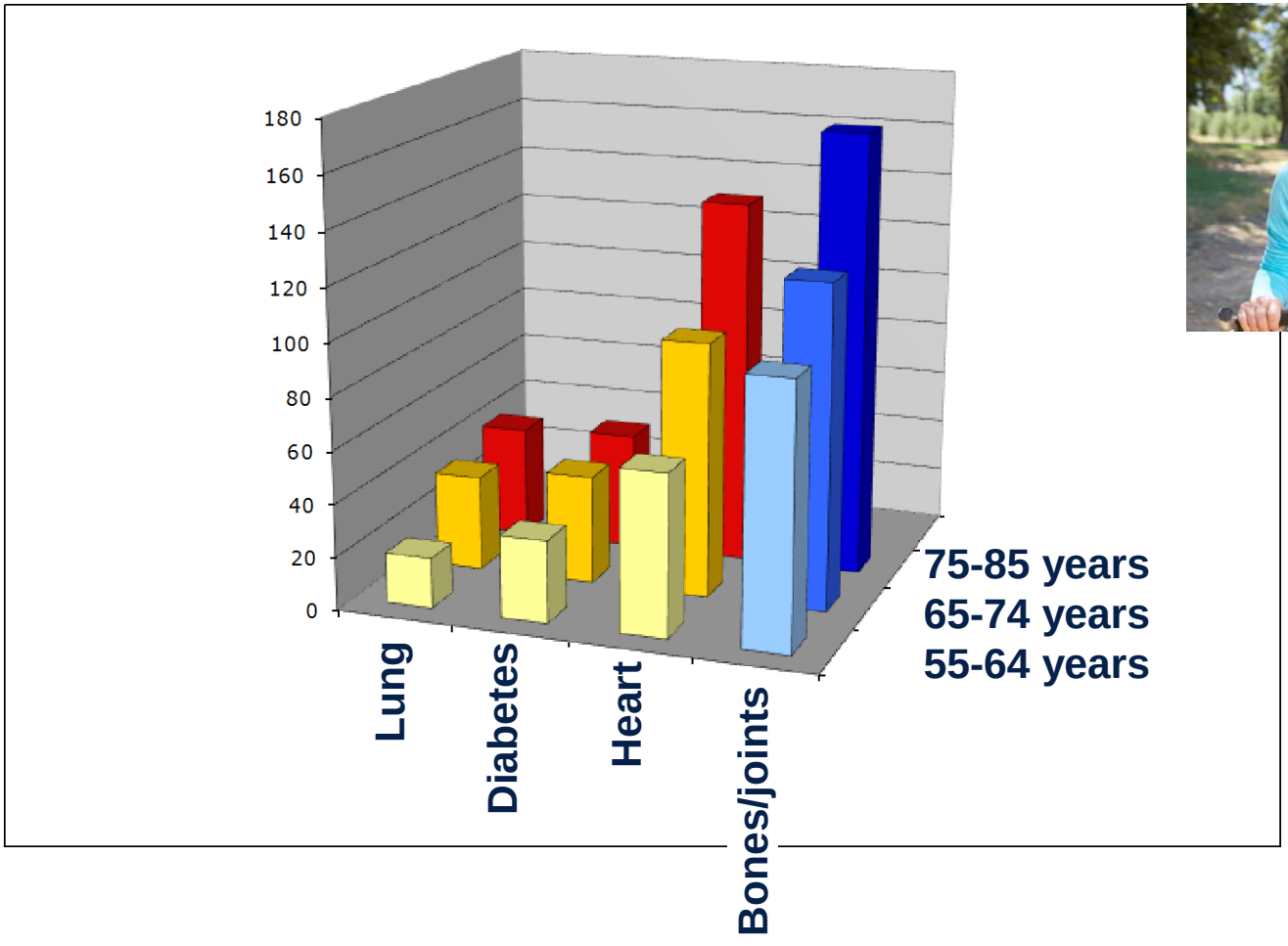
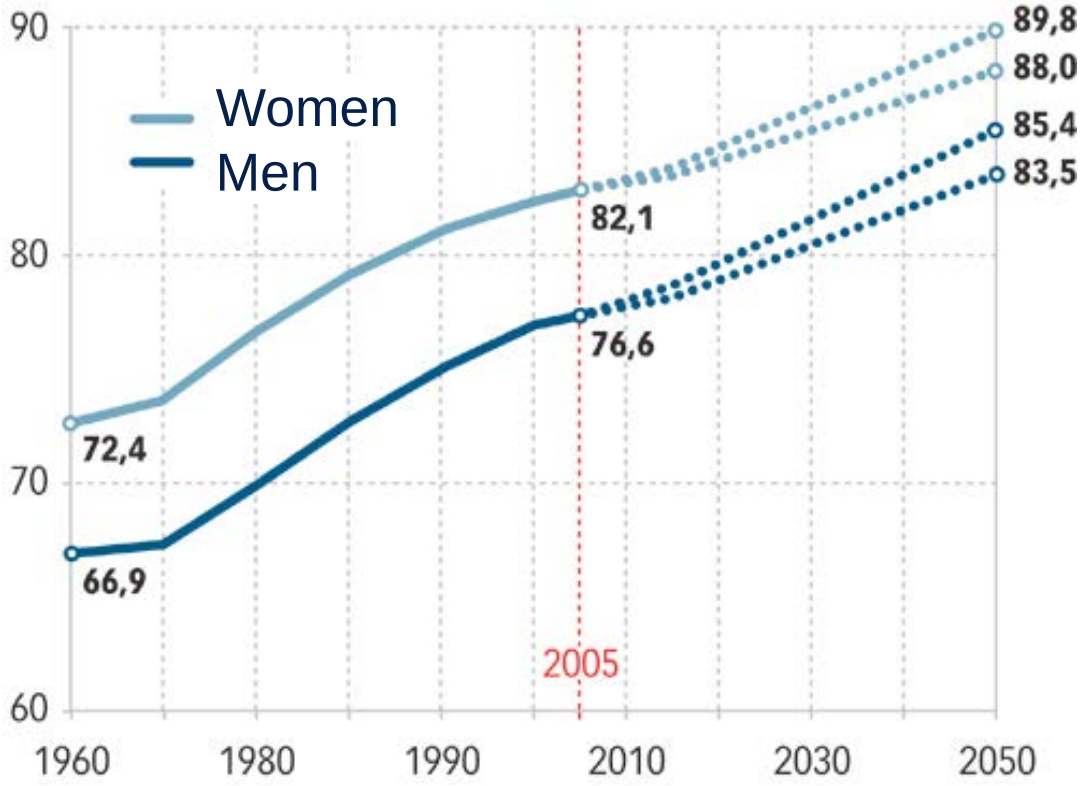
Disability



National Center for Health Statistics, United States, 2009

Life Expectancy



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Diagnosis with Radiographs

Diagnosis with MRI

Prevention

Risk score

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Diagnosis with Radiographs

Diagnosis with MRI

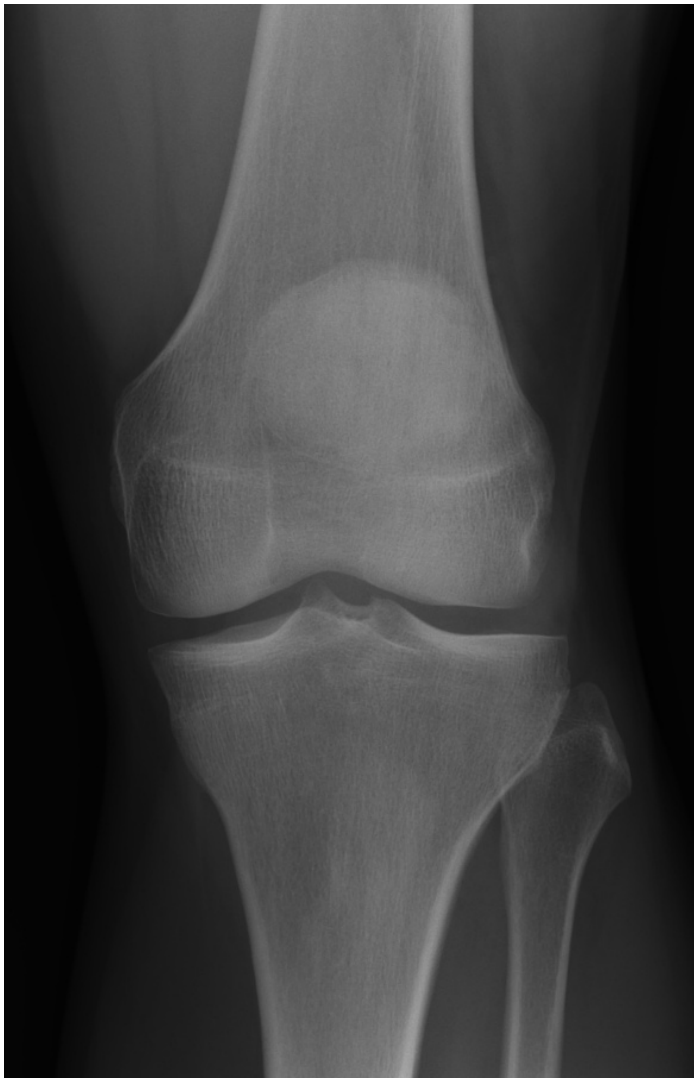
Prevention

Risk score

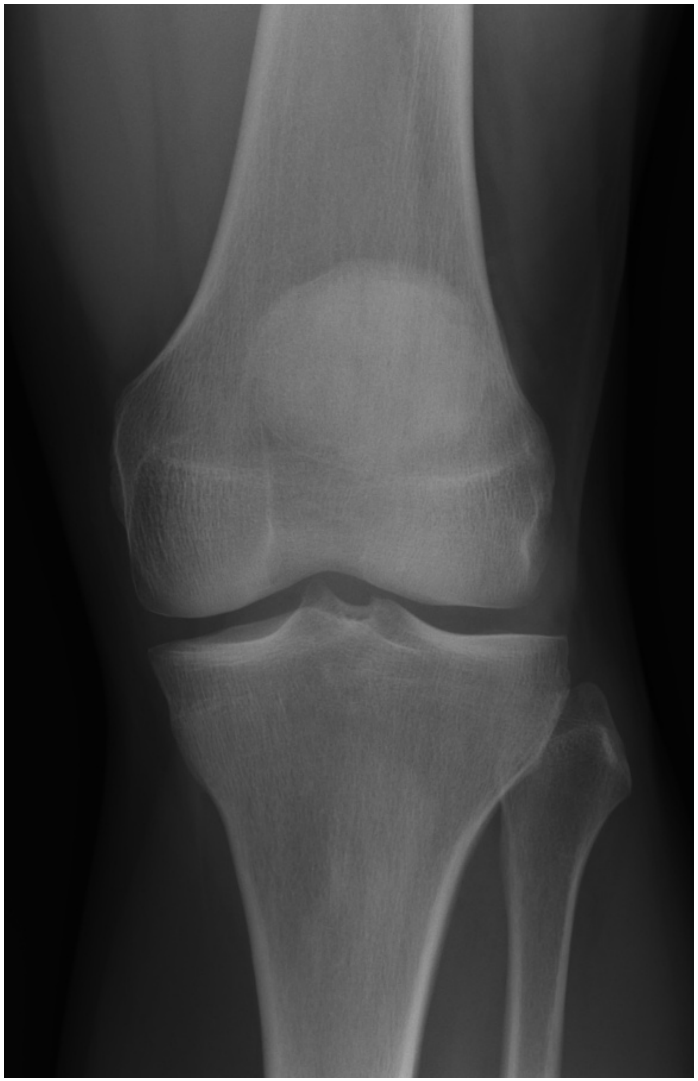
Definition of Osteoarthritis degenerative joint disease

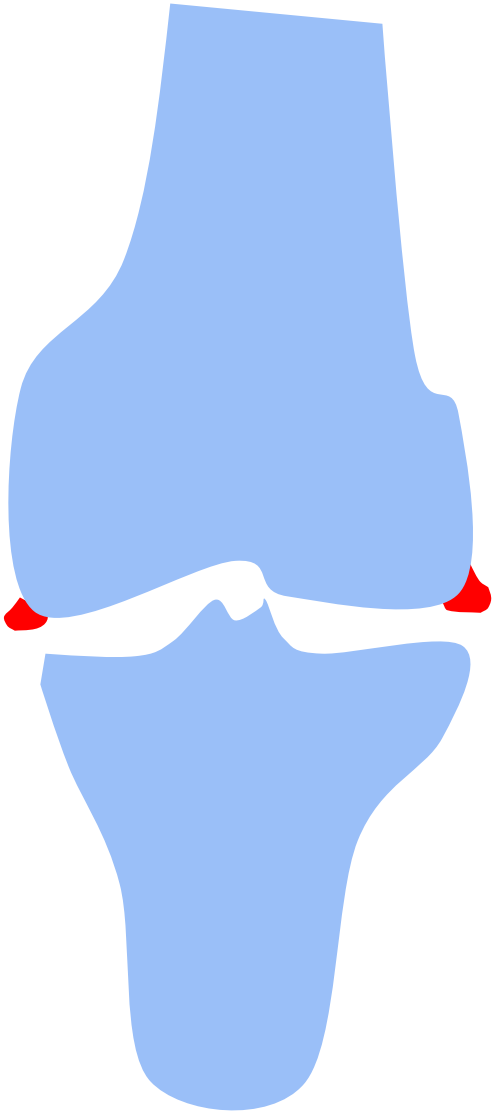
is based on clinical symptoms and on Radiographs/X-rays

knee

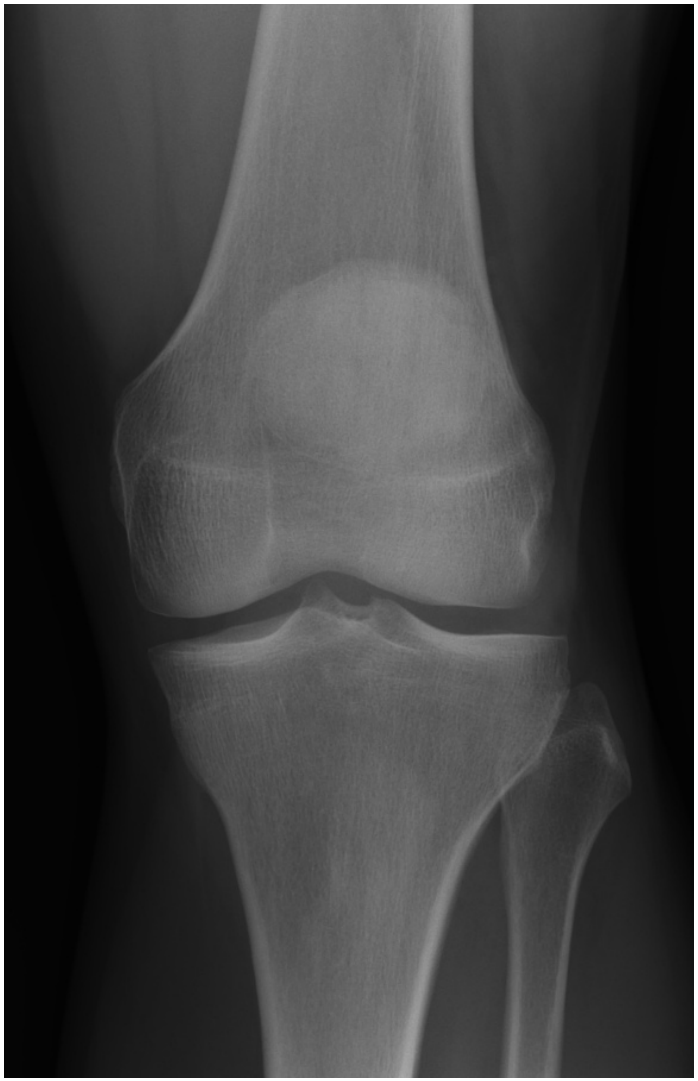


Knee - normal

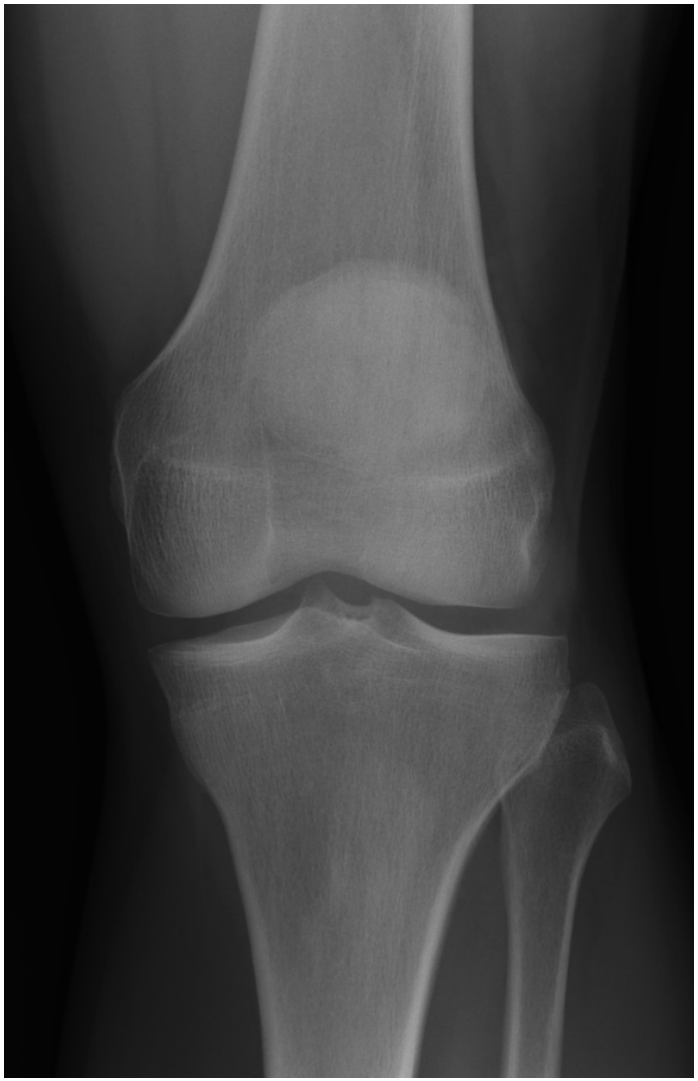


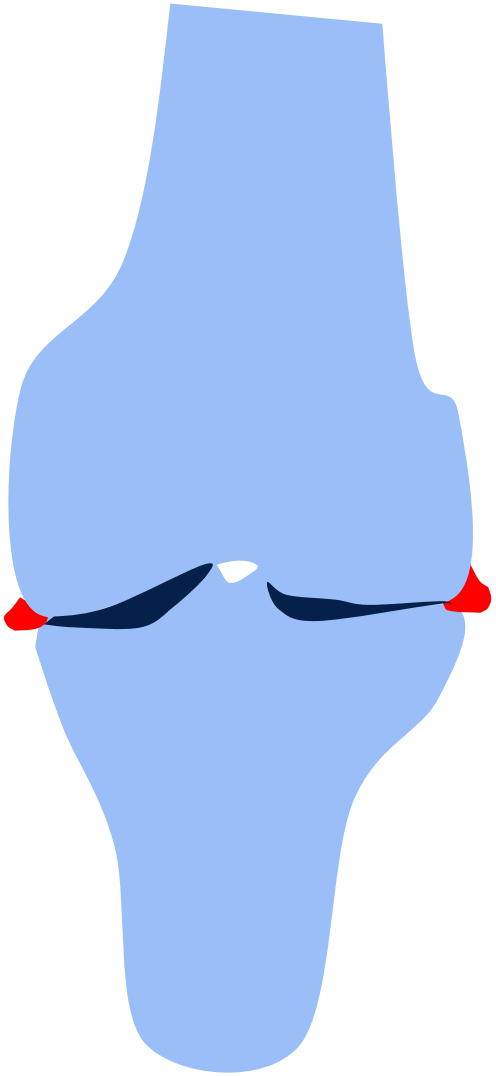


Knee – mild osteoarthritis

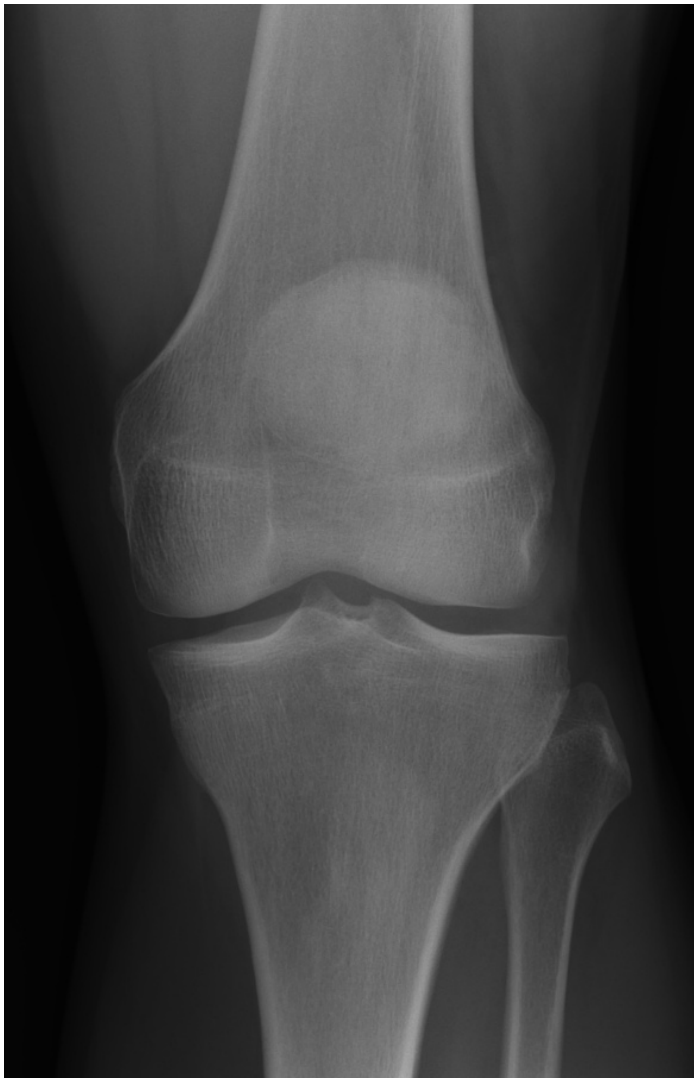


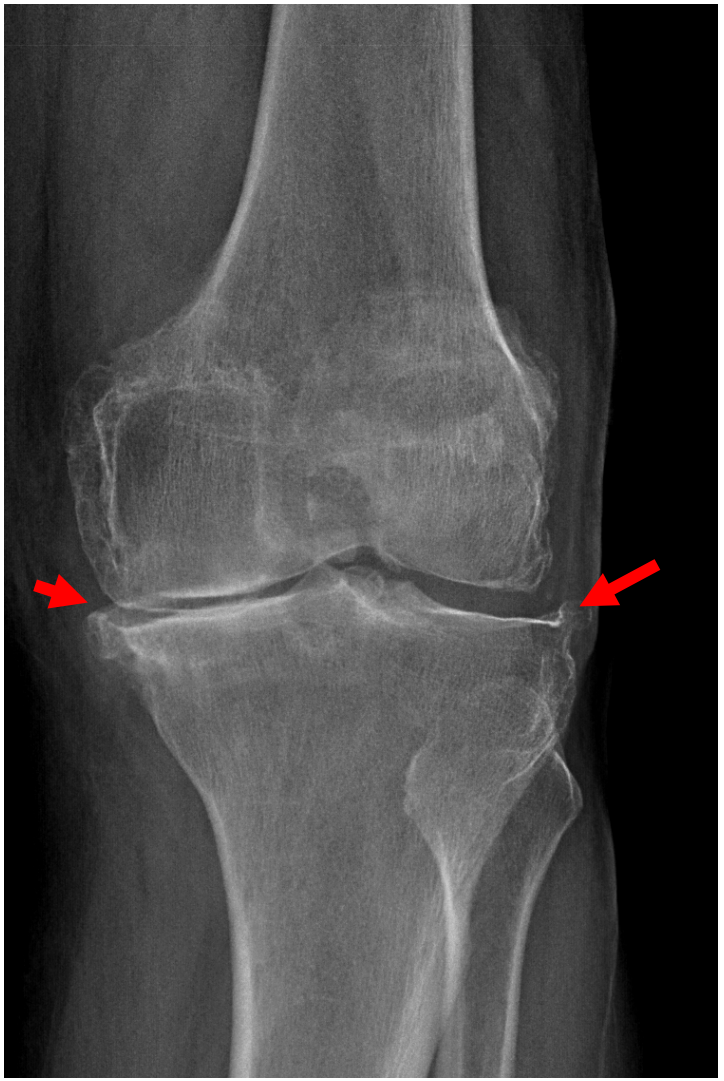
Knee – mild osteoarthritis



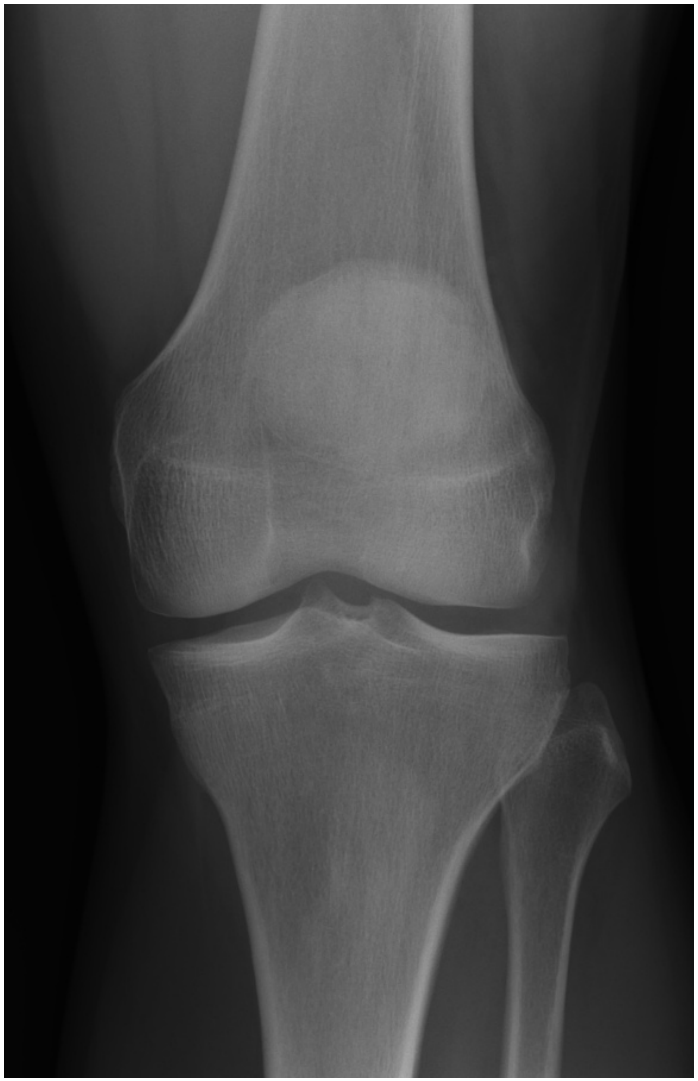


Knee – moderate osteoarthritis





Knee – moderate osteoarthritis



Knee – severe osteoarthritis

Knee – severe osteoarthritis

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Diagnosis with Radiographs

Diagnosis with MRI

Prevention

Risk score

MRI / Magnetic Resonance Imaging

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MRI / Magnetic Resonance Imaging

cartilage – bone - meniscus

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MRI / Magnetic Resonance Imaging

cartilage – bone - meniscus

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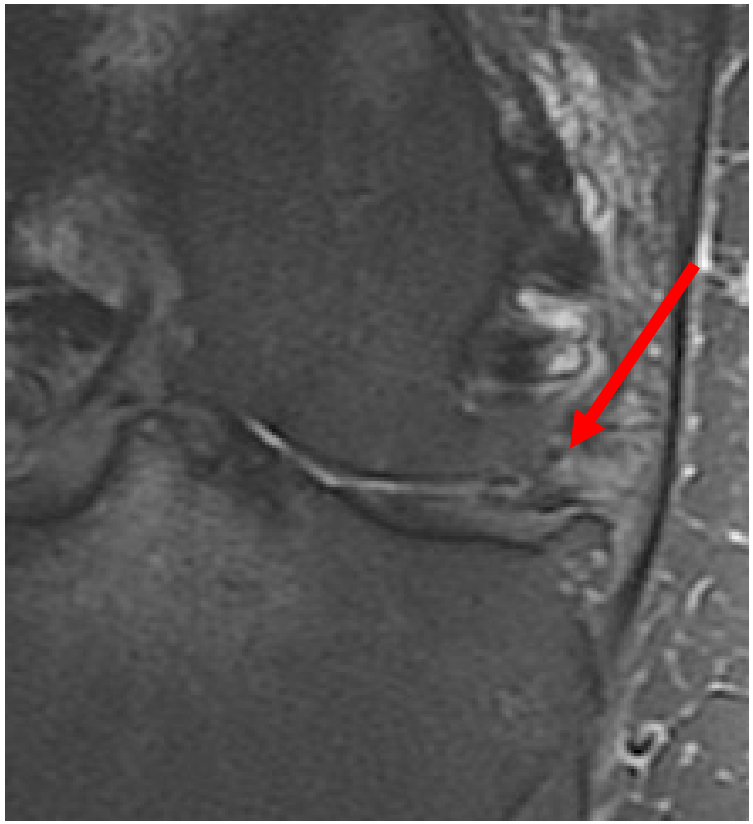
MRI / Magnetic Resonance Imaging



cartilage – bone - meniscus

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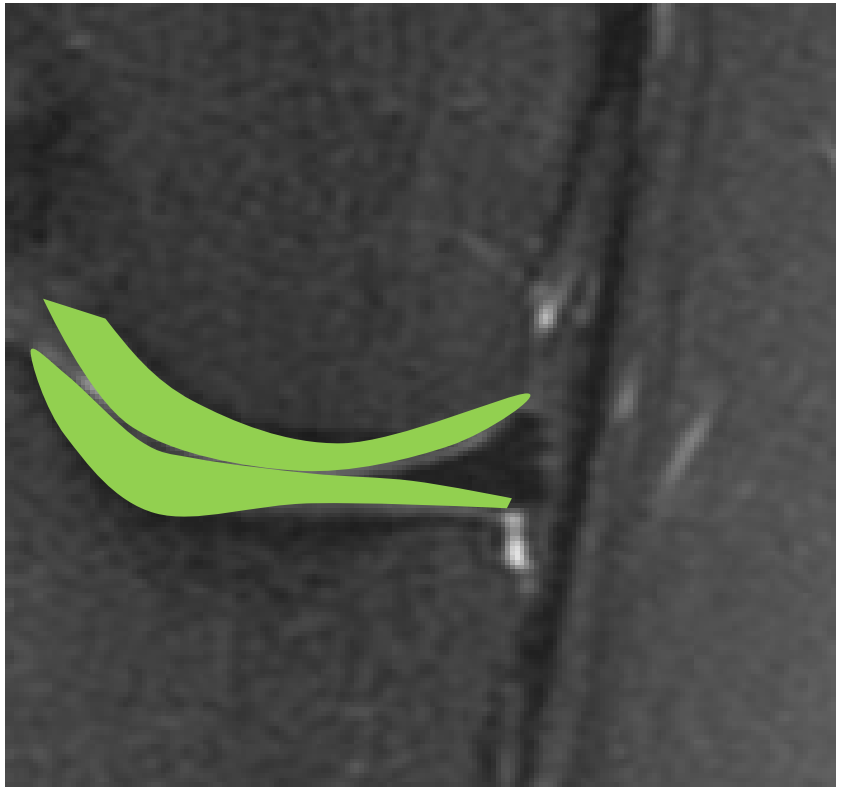
MRI / Magnetic Resonance Imaging



cartilage – bone - meniscus

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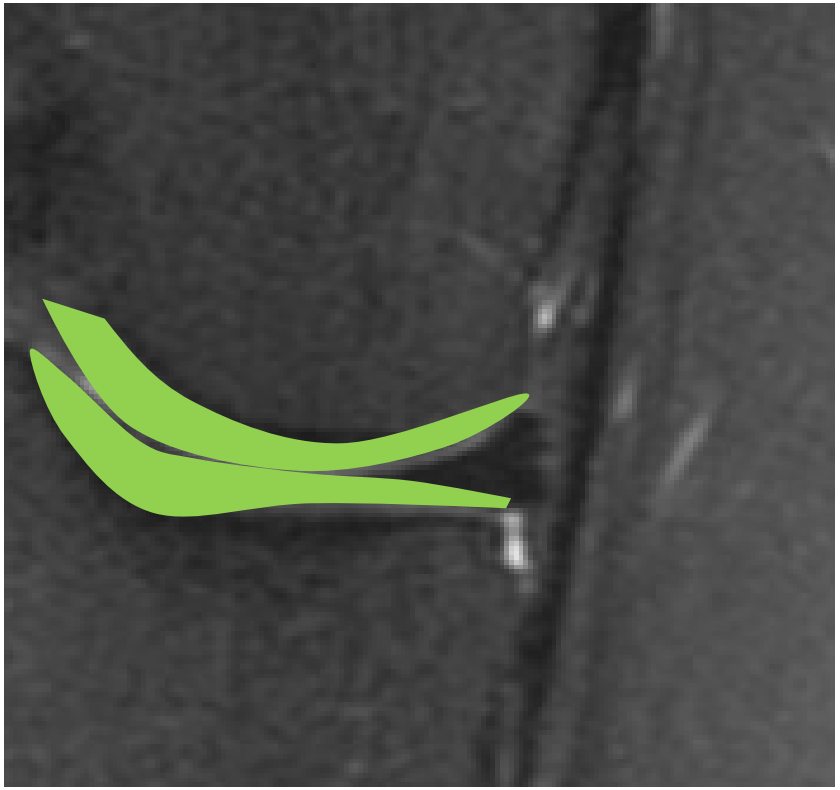
MRI / Magnetic Resonance Imaging



cartilage – bone - meniscus

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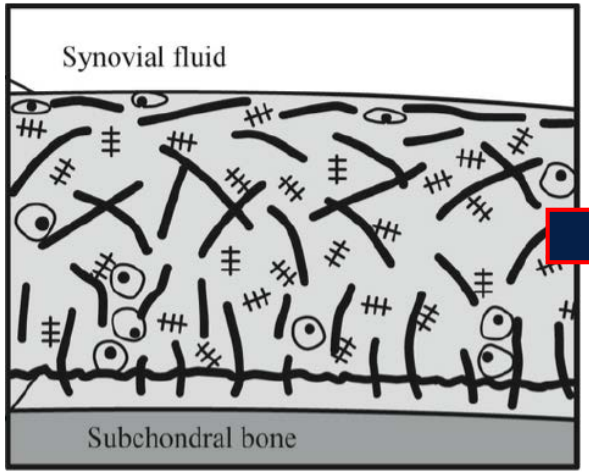
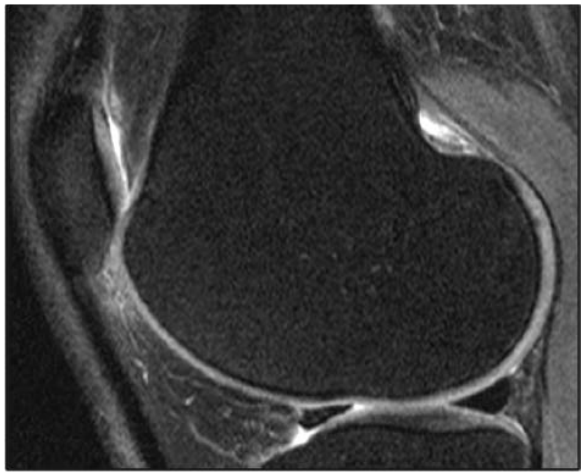
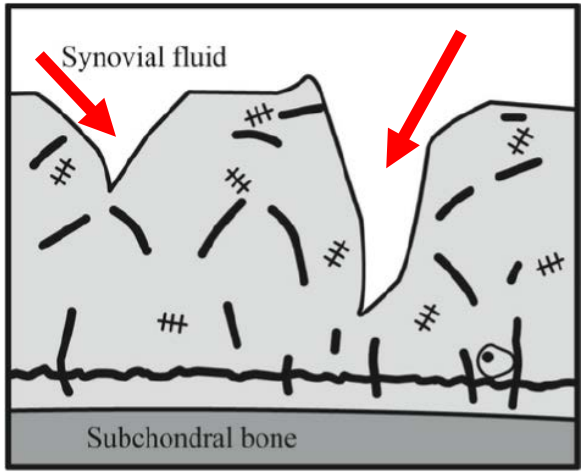
Evolution of cartilage in OA

Healthy Cartilage





Cartilage loss



Cartilage loss

Irreversible

Does not grow back

Leads to osteoarthritis

Collagen Proteoglycans Chondrocytes

Illustrations from Matzat et al. Quant Imaging Med Surg. 2013

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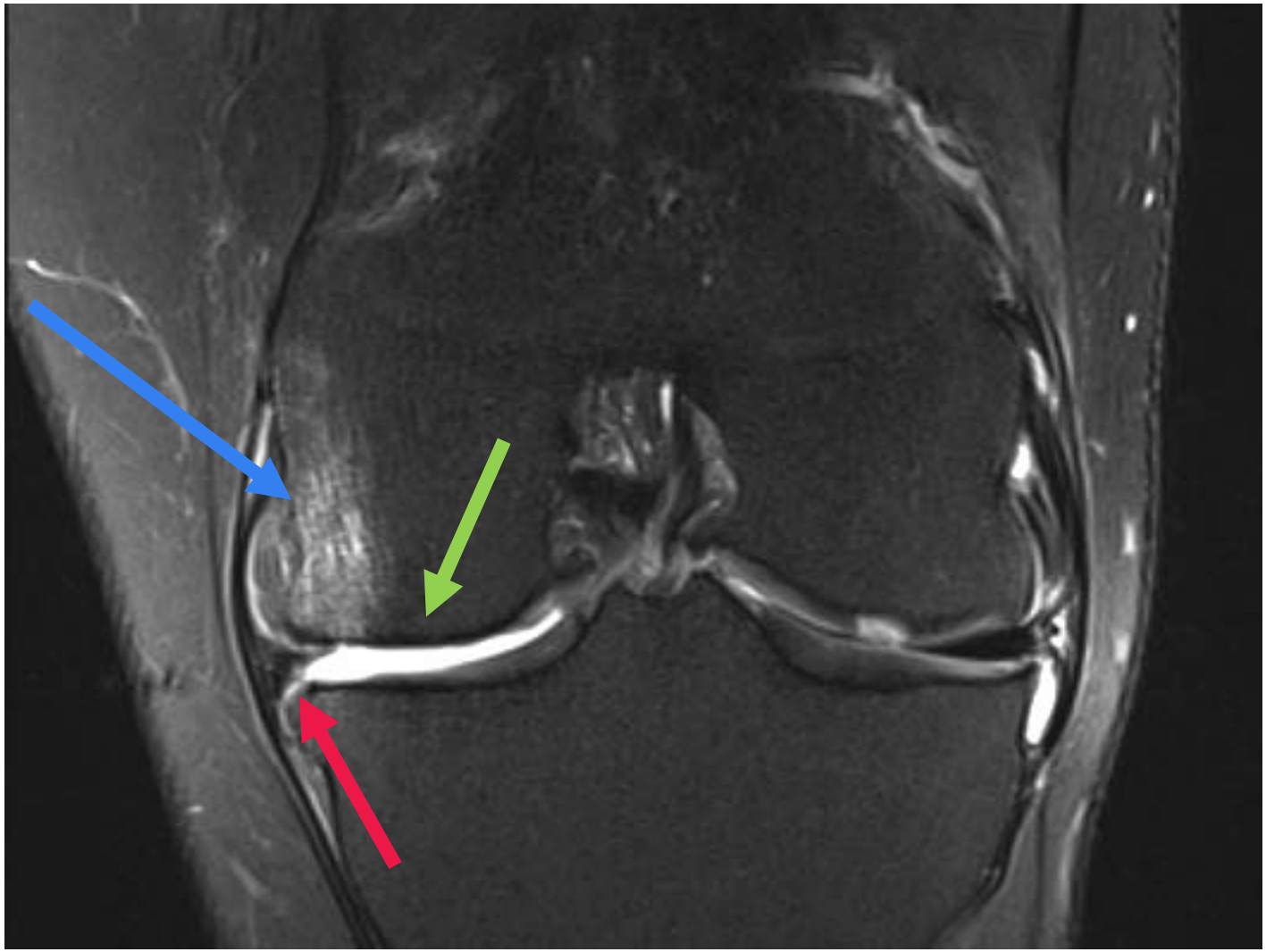
MRI / Magnetic Resonance Imaging



Osteoarthritis – 29 year old man

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MRI / Magnetic Resonance Imaging

Osteoarthritis – ACL degeneration
45 yo woman

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Diagnosis with Radiographs

Diagnosis with MRI

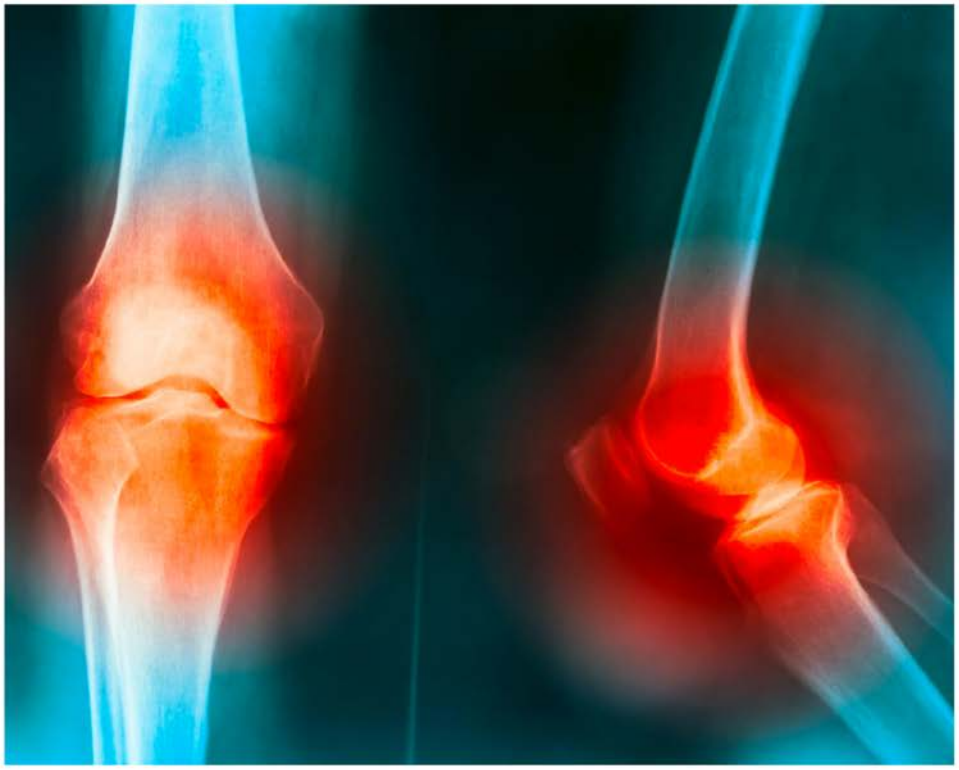
Prevention

Risk score

From the Press

Osteoarthritis: Knee joint degeneration slowed with weight loss, study confirms

By Honor Whiteman | Published Tuesday 2 May 2017



Researchers have found that weight loss can slow degeneration of the knee joint.

Medical News Today 5/2017

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Obesity and Osteoarthritis (OA)

Obesity: modifiable risk factor for OA

↓

Weight loss slows OA[1]

↓

Improvement of clinical symptoms[2]

↓

Is **a higher degree of weight loss** associated with improved **cartilage health?**

[1] Serebrakian et al. JMRI 2014

[2] Edwards et al. Arthritis 2012

Illustration from www.clinicaladvisor.com

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Molecular T2 Relaxation Time Mapping

Early molecular changes
Compositional T2 imaging

- collagen content ↓
- free water ↑

Assessment of **molecular cartilage composition** **before cartilage lesions** occur

Courtesy Zarnowski

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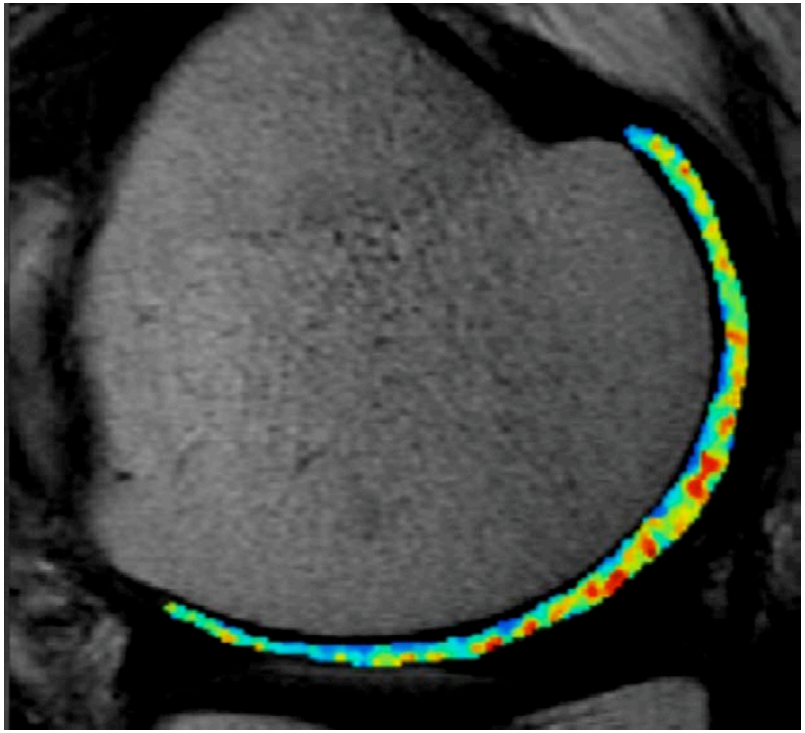
Obesity and Osteoarthritis (OA)

MRI T2 measurements to detect **molecular changes before** cartilage damage

Do **different degrees of weight loss** have a **different impact on cartilage health?**



[1] Joseph et al. Arthritis Research & Therapy 2011

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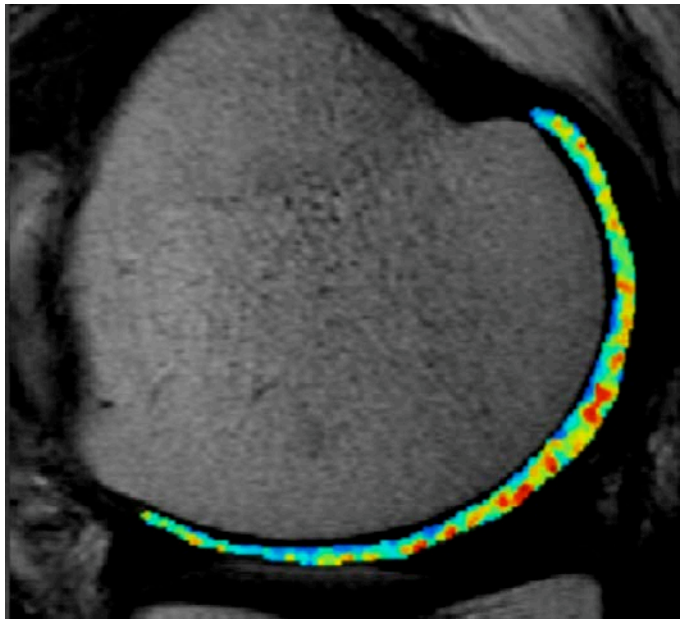
Magnetic resonance imaging (MRI)

Baseline → **48-month follow-up**



- Molecular cartilage imaging: T2 relaxation time

[1] Joseph et al. Arthritis Research & Therapy 2011

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Patient selection

506 patients from the **OAI**

age 62.4±9.3y, 60.6% females

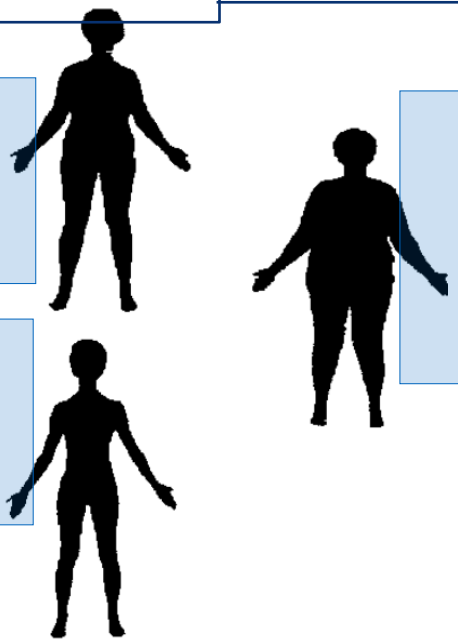
BMI 30.2±3.5 **– obese or overweight subjects**

5-10% weight loss

177 subjects

>10% weight loss

76 subjects



patients not loosing weight

253 subjects

[1] Holdsworth et al. Int J Obes Relat Metab Disord. 2004

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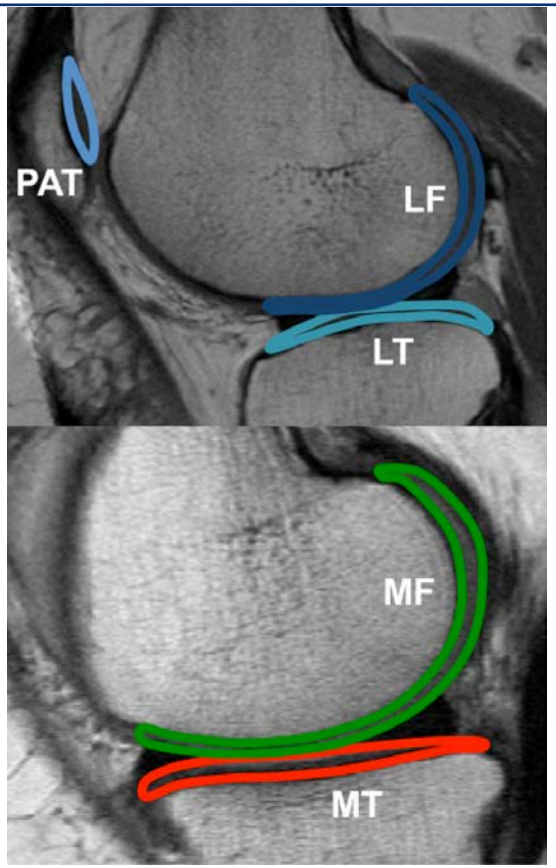
Results

Magnetic resonance imaging (MRI)

Baseline → **48-month follow-up**



[1] Joseph et al. Arthritis Research & Therapy 2011
[2] Yu et al. Osteoarthritis Cartilage 2015

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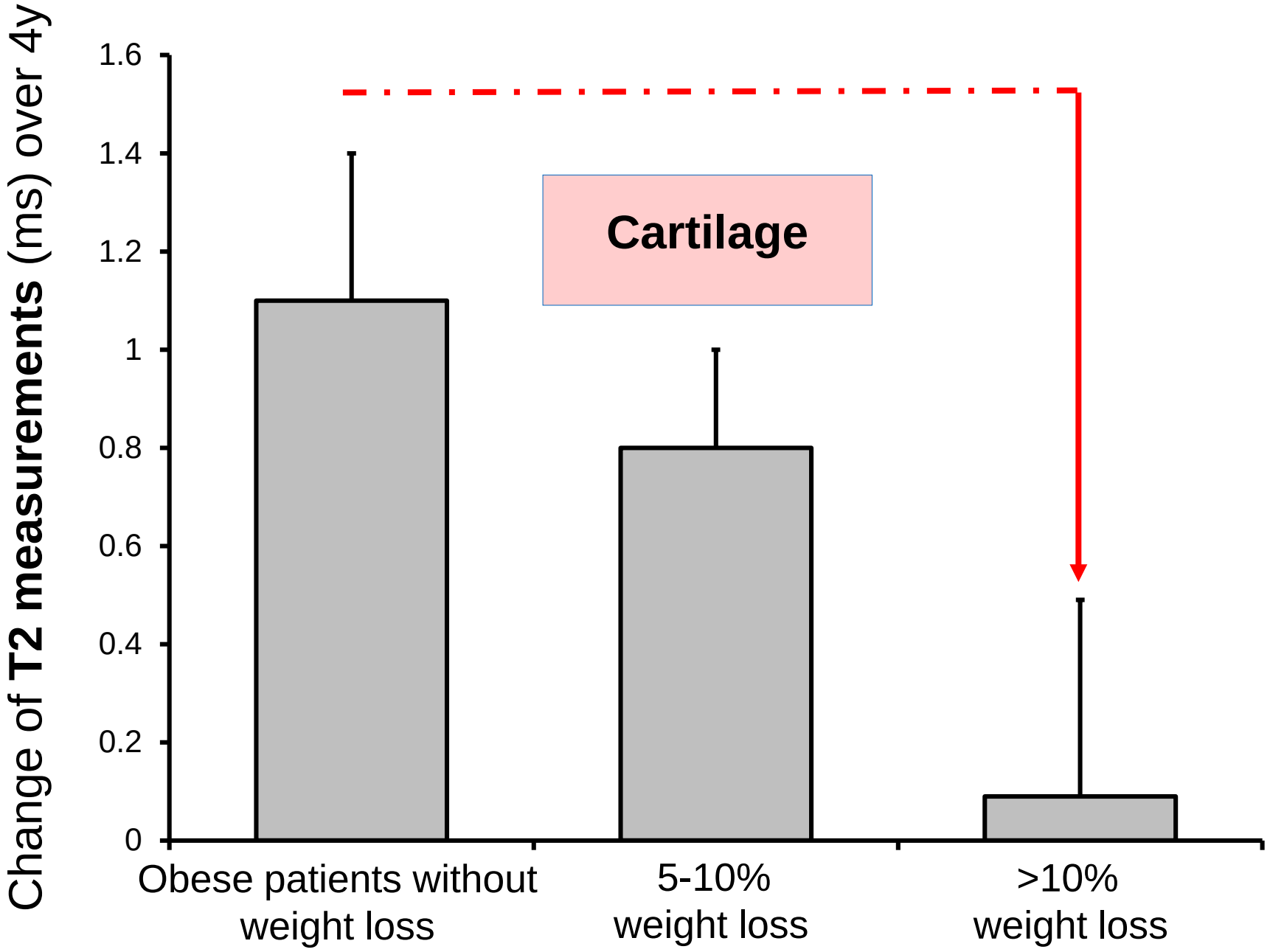
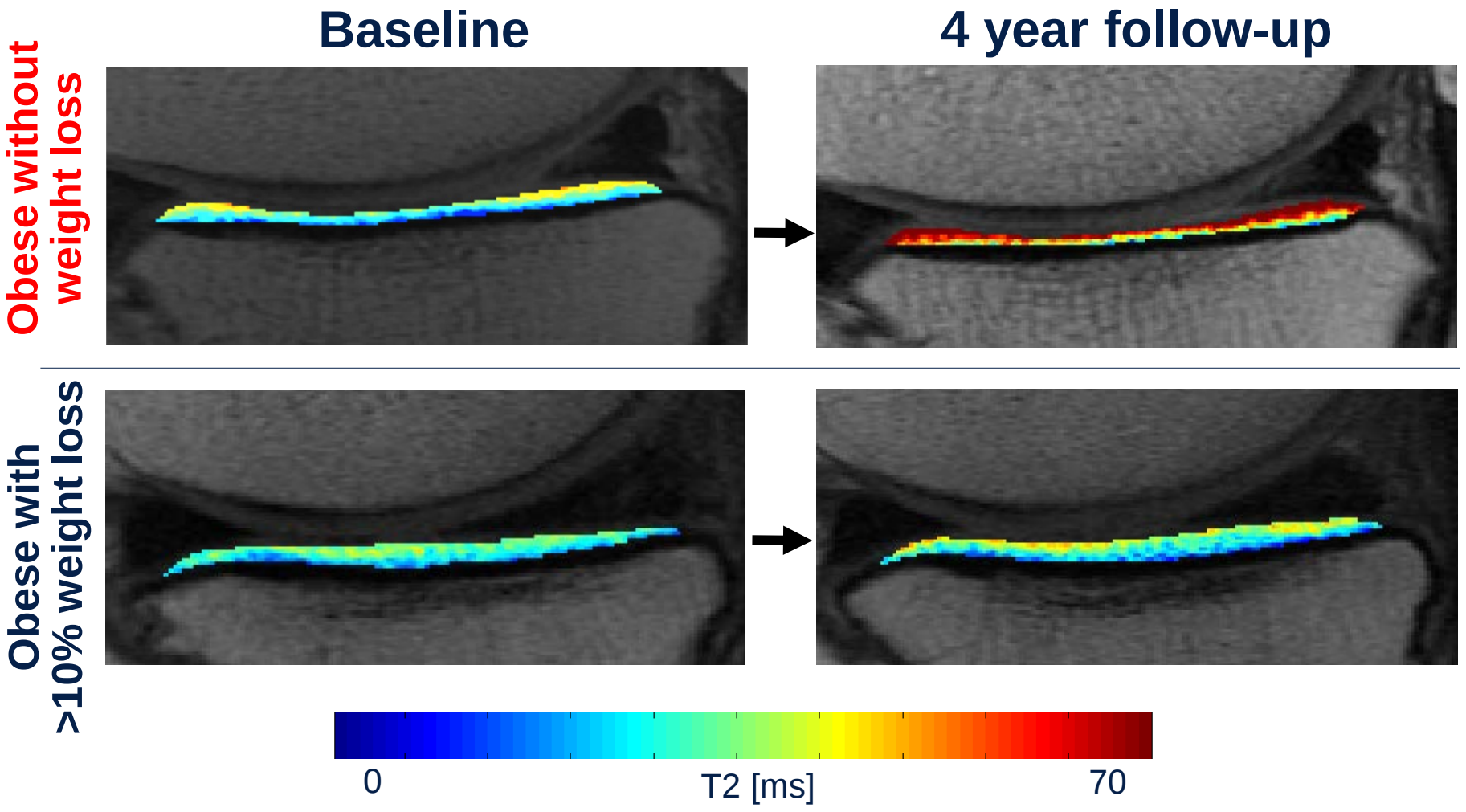

Change of T2 measurements (ms) over 4y
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Cartilage
Obese patients without weight loss
5-10% weight loss
>10% weight loss

Cartilage molecular T2 maps of medial tibia



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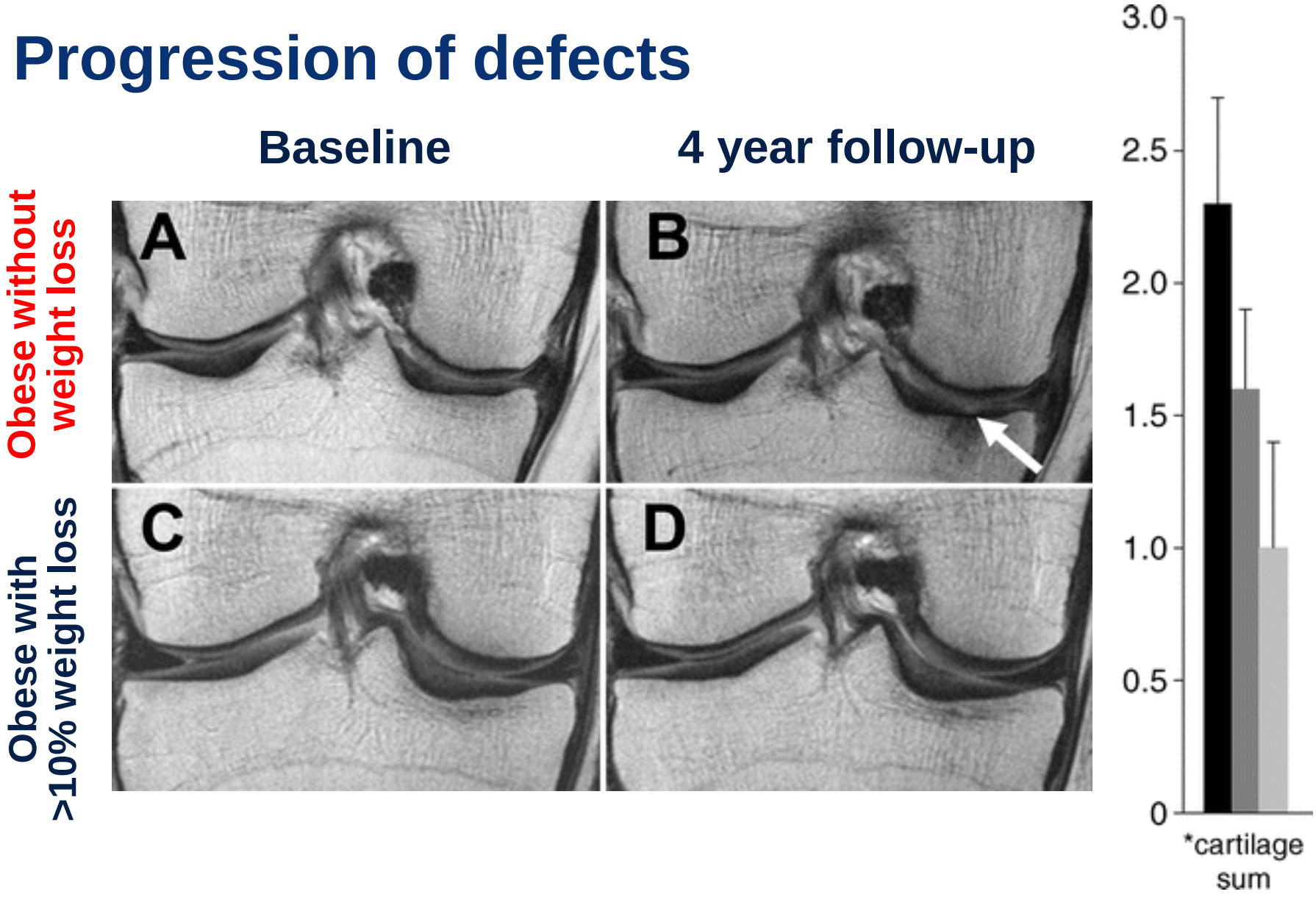
Progression of defects



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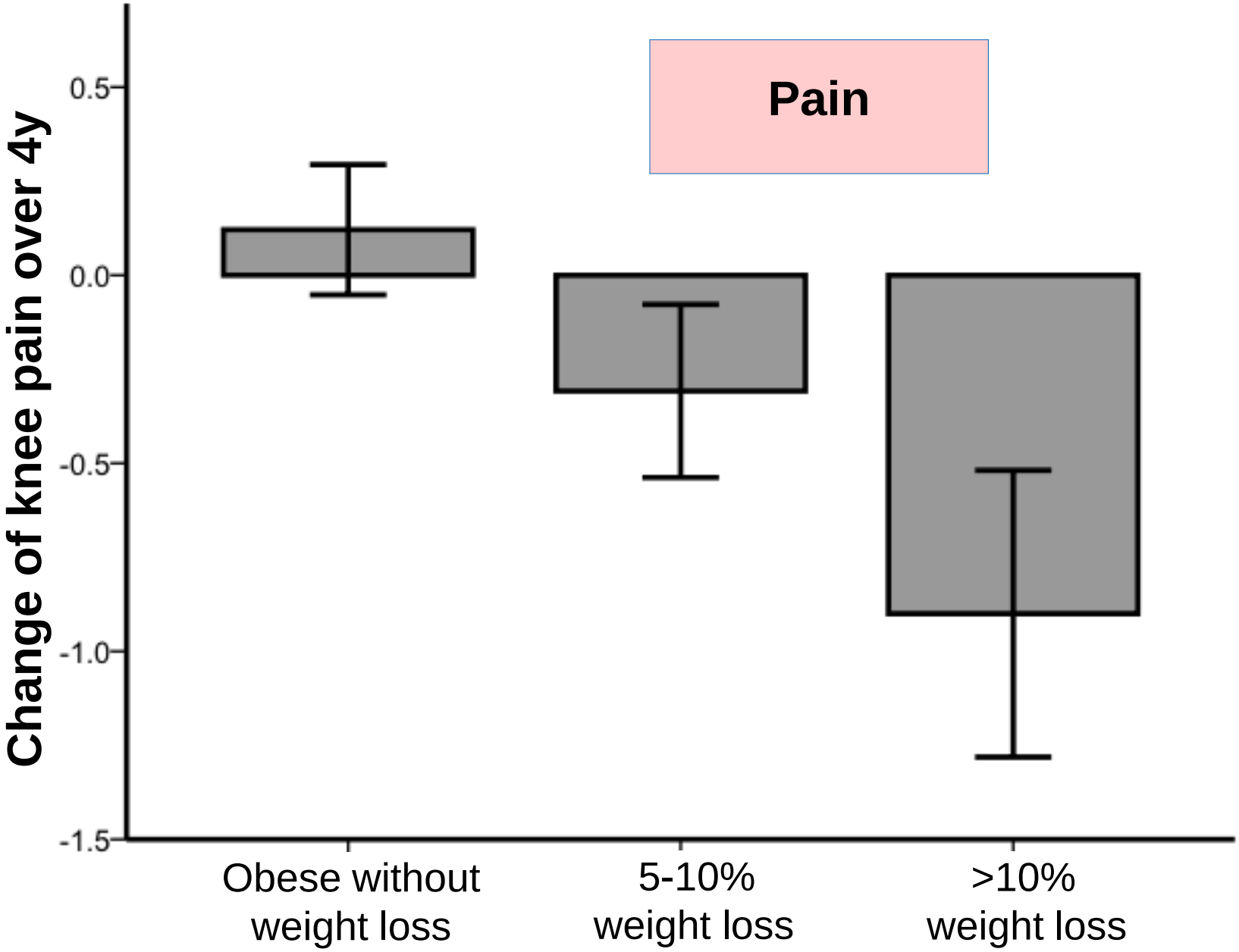

Pain
Change of knee pain over 4y
0.5
0.0
-0.5
-1.0
-1.5
Obese without weight loss
5-10% weight loss
>10% weight loss

Conclusion

Obese and overweight patients with risk factors or mild to moderate radiographic evidence for OA:

- **protective aspect** of **weight loss** on cartilage
- patients with **>10% weight loss benefit significantly more** than patients with little or no weight loss
- potentially weight loss can prevent end stage OA

Forbes 10-2017

OCT 18, 2017 @ 11:50 AM 10,189

The Little Black Book of Billionaire Secrets

Excessive Exercise May Harm The Heart, Study Suggests

Alice G. Walton, CONTRIBUTOR

I cover health, medicine, psychology and neuroscience. FULL BIO

Opinions expressed by Forbes Contributors are their own.

There's a sweet spot when it comes to exercise, it seems. Studies have found that too little exercise doesn't produce the health benefits we're after, while too much may, counterintuitively, harm the body rather than help it. To this end, a new

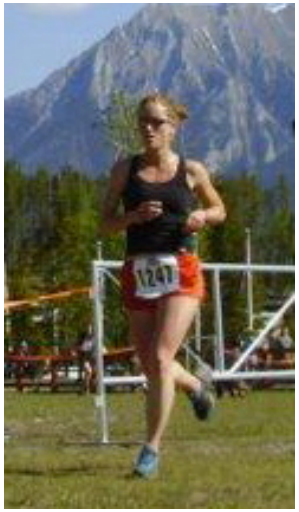
Physical Activity and Osteoarthritis

WGN-TV Chicago News 11/2009

RSNA Press conference 11/2011

Background

- **Loading** = essential for normal cartilage development
  - If excessive, may lead to degeneration over time
- **Association of exercise with OA development** is unclear
  - Detrimental, beneficial, no effect on articular cartilage

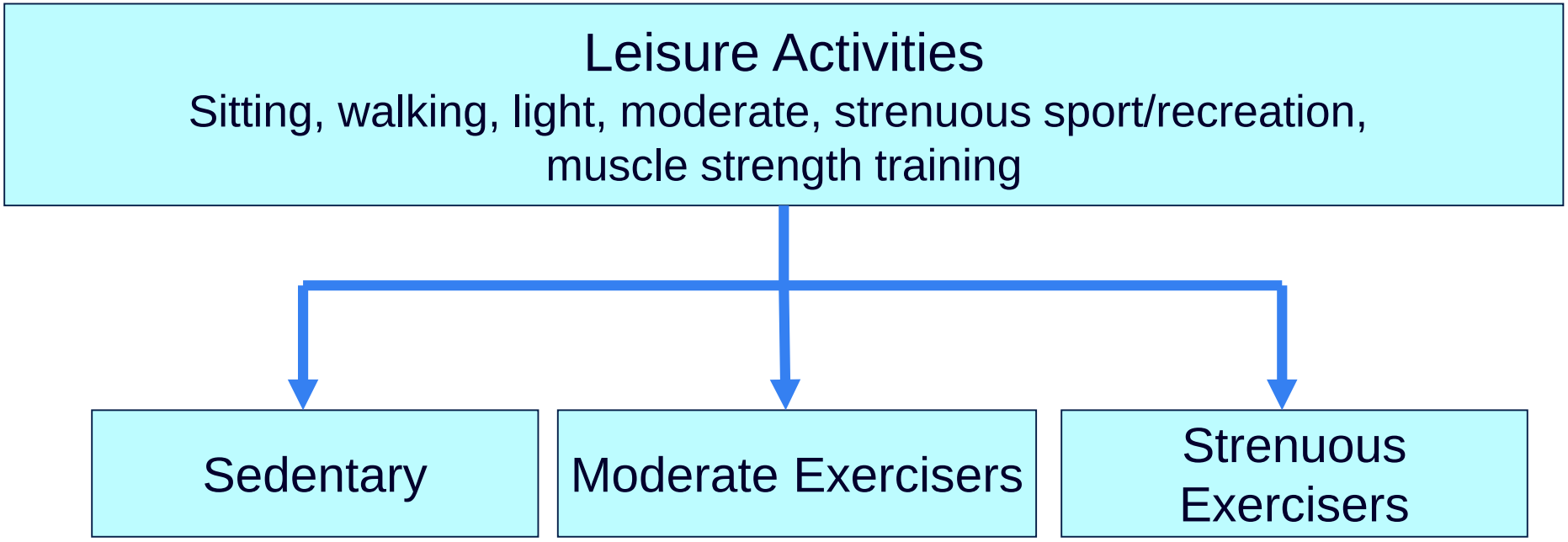


To evaluate the effects of exercise

on knee cartilage

in middle-aged, asymptomatic subjects with and without OA risk factors

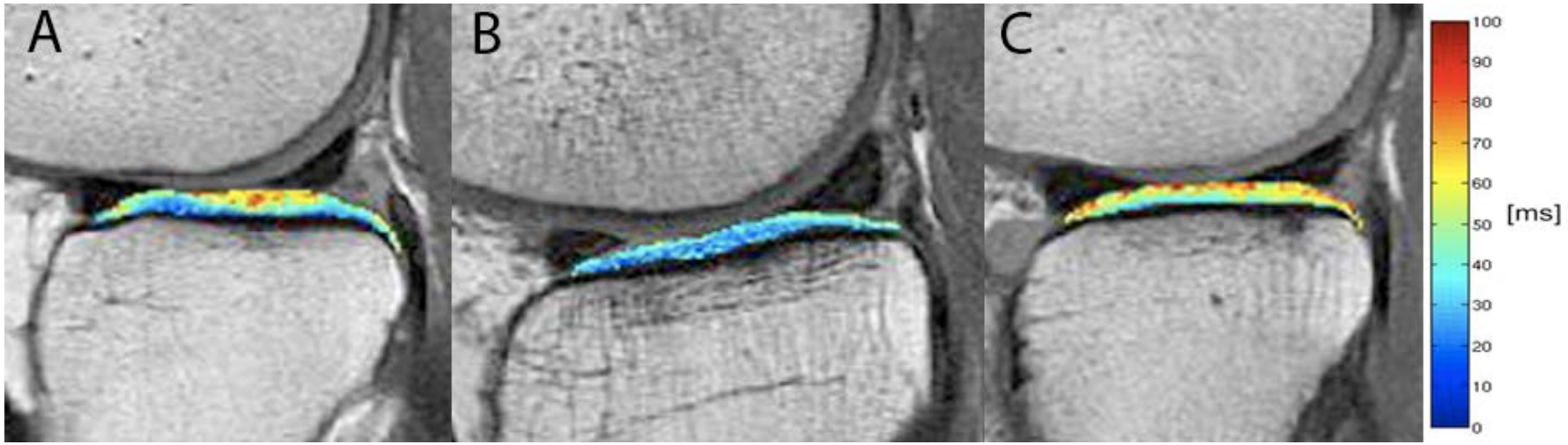
- **3 domains of physical activity over last 7 days**
  - **Leisure, household, and occupational activities**



EXERCISE LEVEL CLASSIFICATION

E_1	E_2	E_3
Sedentary	**Light-moderate Exercisers**	**Strenuous Exercisers**
Does sitting activities and walks ≤2 days/wk for <2 hrs/day	Walks ≥3 days/wk for <2 hrs/day or walks this amount and does light sport/recreation for <2 hrs/day on any given day	Moderate or strenuous sport/recreation ≥3 days/wk for >1 hr/day
Watch TV, read books, play on computer, play	Walking, darts, table tennis, catch, fishing, frisbee, bowling	Running, basketball, cycling, tennis, soccer,

Results



Sedentary

Light-moderate Exerciser

Strenuous Exerciser

CONCLUSIONS

Subjects with knee OA risk factors:

Mild - moderate exercisers = ↓ T2 values

⇨ Indicative of healthier cartilage

Strenuous exercisers = ↑ T2

Associated with more degenerated cartilage

Recommendations

In line with

American Heart Association Recommendations for Physical Activity in Adults

150 minutes per week of moderate exercise or 75 minutes per week of vigorous exercise (or a combination of moderate and vigorous activity). Thirty minutes a day, five times a week is an easy goal to remember

Avoid too much high impact activity !

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Diagnosis with Radiographs

Diagnosis with MRI

Prevention

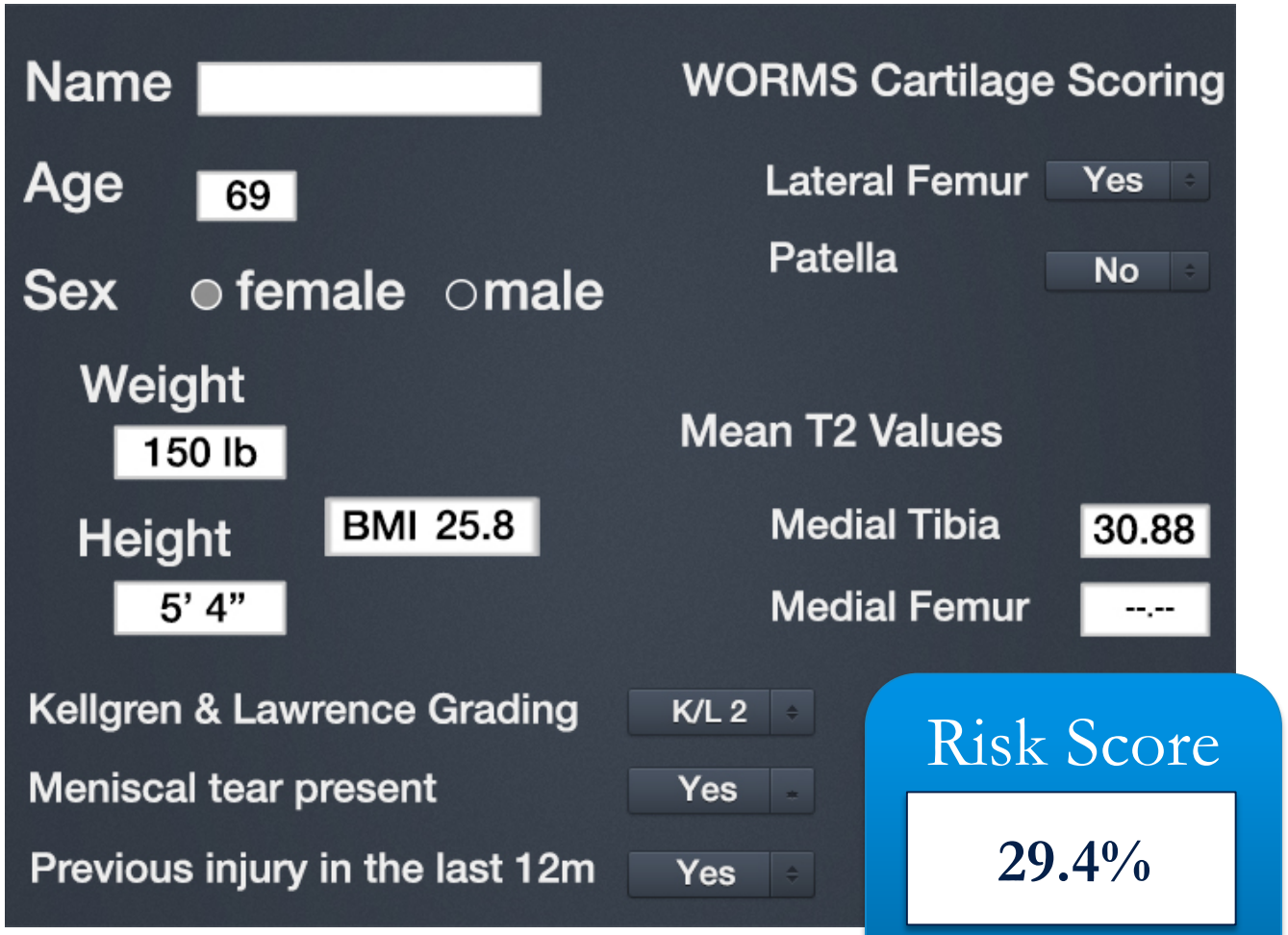
Risk score

8 year Outcome Variables

Radiographic or clinical osteoarthritis or total joint replacement	N (%) of 641
	34 (5.31%)
	53 (8.27%)
	8 (1.25%)
	80 (12.48)

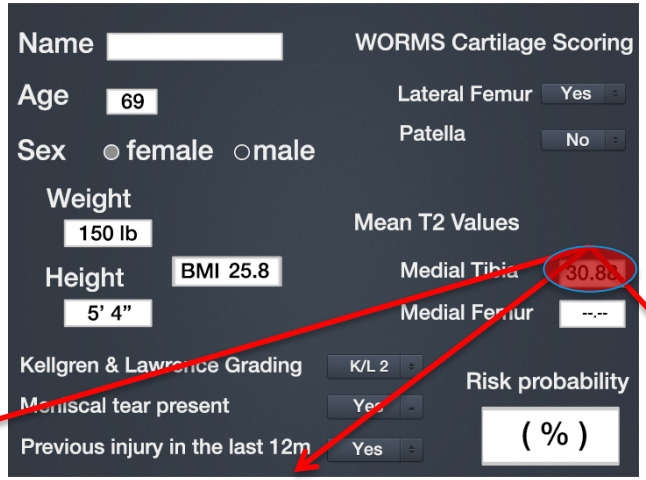
J Magnetic Resonance Imaging, 2017, in press

Risk score model



J Magnetic Resonance Imaging, 2017, in press

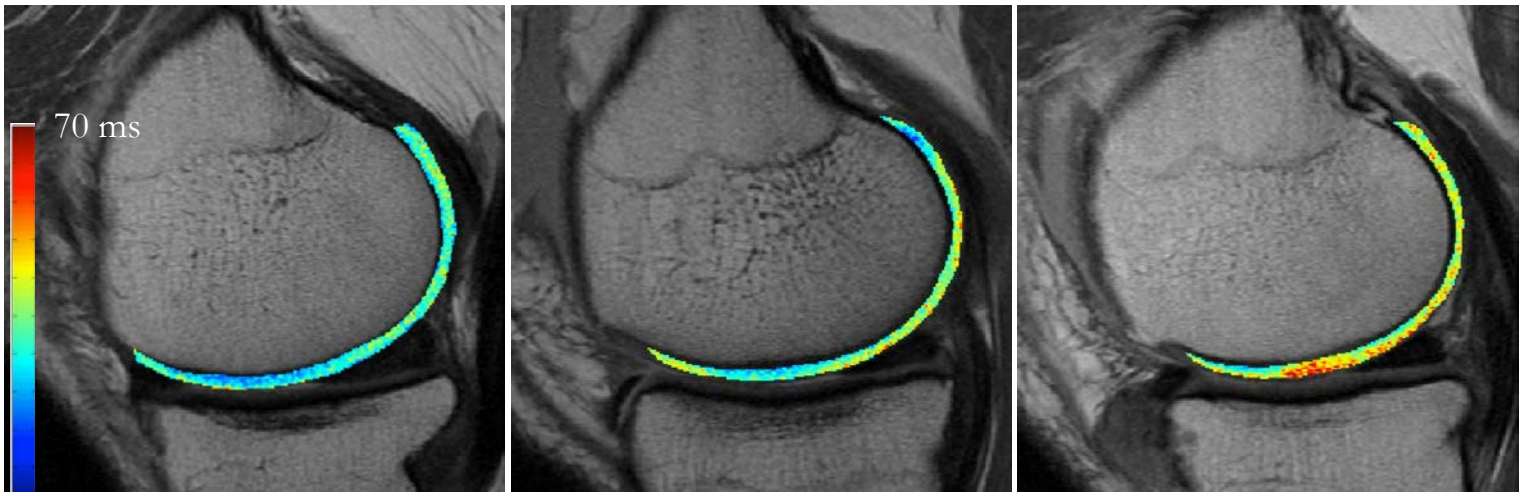
Effects of varying T2 values



Medial Femur T2 [ms] 30.8

Medial Femur T2 [ms] 37.6

Medial Femur T2 [ms] 42.3



Low risk: 34.1%

Med Risk: 57.5%

High Risk: 75.1%

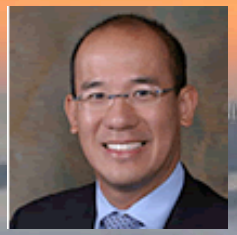
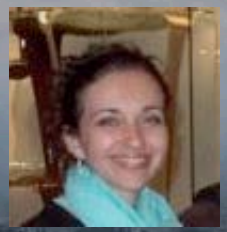
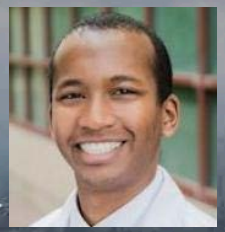
Acknowledgments









Acknowledgments

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GSK

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Thank you!