

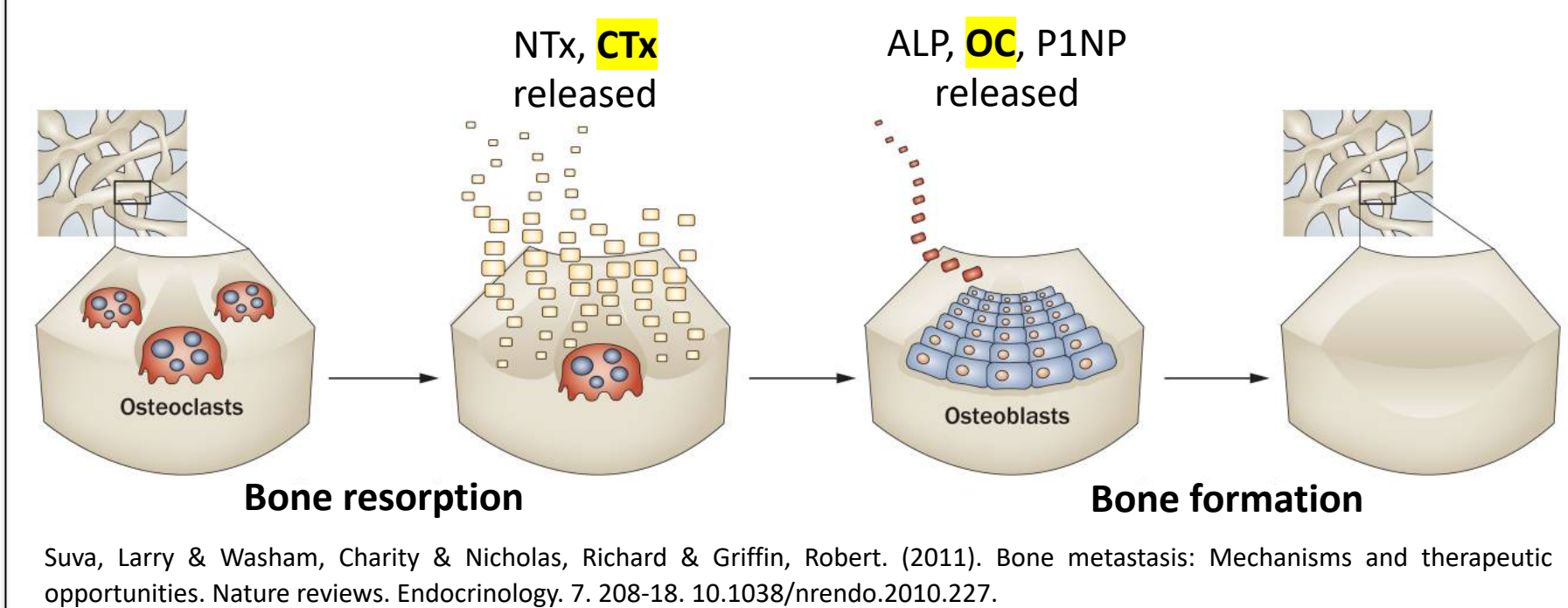
# Is Poor Bone Quality Associated with Pain After Total Knee Arthroplasty?

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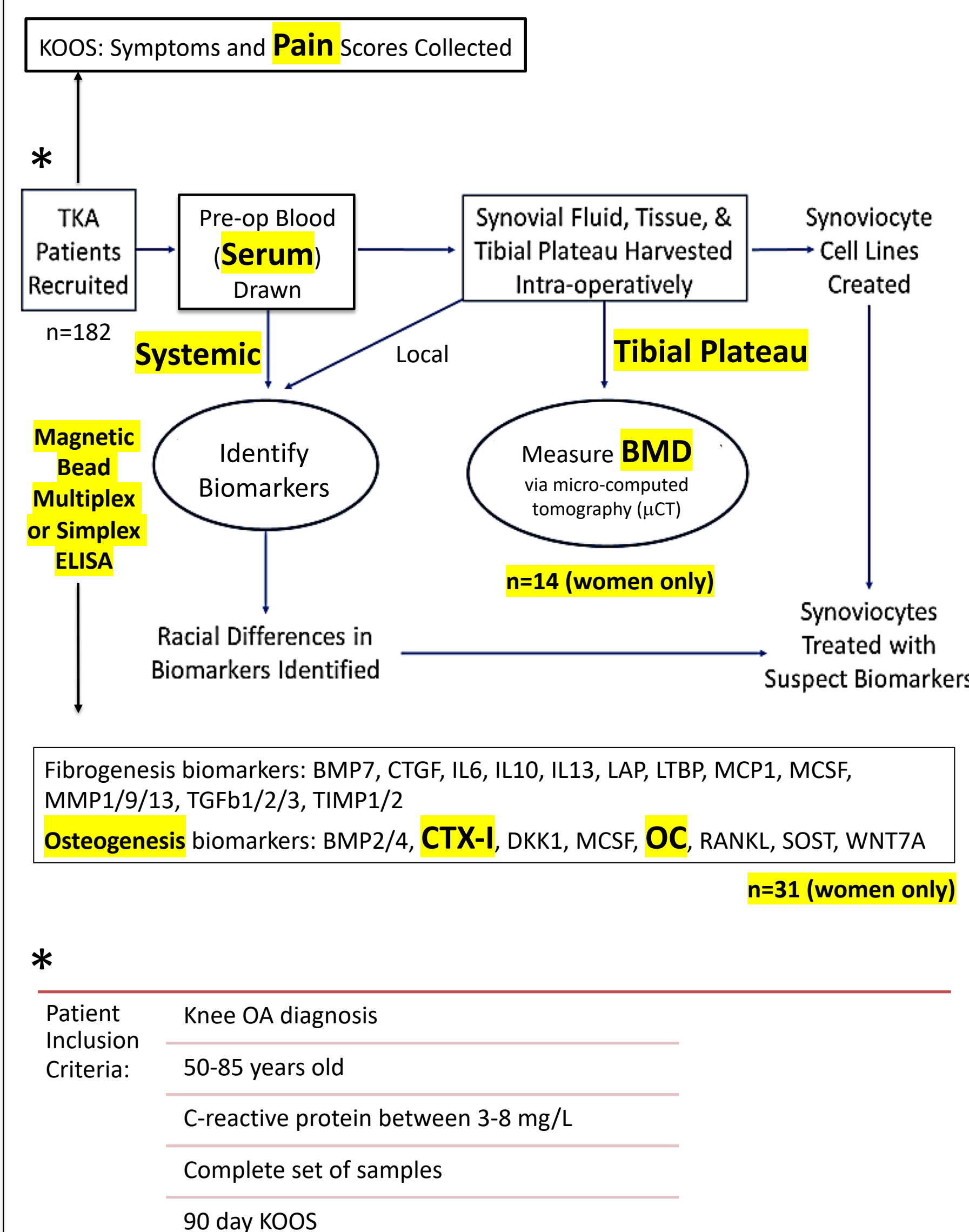
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## Introduction

- Osteoporosis, a defect in the normal ratio of bone resorption and formation, is often undiagnosed in osteoarthritis (OA) patients prior to undergoing total knee arthroplasty (TKA) [1].
- The American Academy of Orthopedic Surgeons does not offer a recommendation regarding screening for bone mineral density (BMD) of TKA candidates [2].
- Patients suffering from osteoporosis are mostly women and at higher risk of incidental intra- and post-operative fractures. This potentially makes them subject to changes in surgical strategy while undergoing TKA and follow up therapies [3,4].
- In our clinic, black patients report worse pain, as measured by patient reported outcome surveys such as the validated Knee Osteoarthritis Outcome Scores (KOOS).
- Hypothesis: We hypothesize that defects in bone homeostasis, independent from osteoarthritis, increase the susceptibility to post-operative pain.



## Methods



* Patient Inclusion Criteria:	Knee OA diagnosis
	50-85 years old
	C-reactive protein between 3-8 mg/L
	Complete set of samples
	90 day KOOS

Results were analyzed by Pearson's correlation (R) or Student's t-test, where  $p < 0.05$  was deemed significant.

## Results

### BMD and Systemic Indicators of Bone Resorption Correlate to Post-Operative Pain Scores

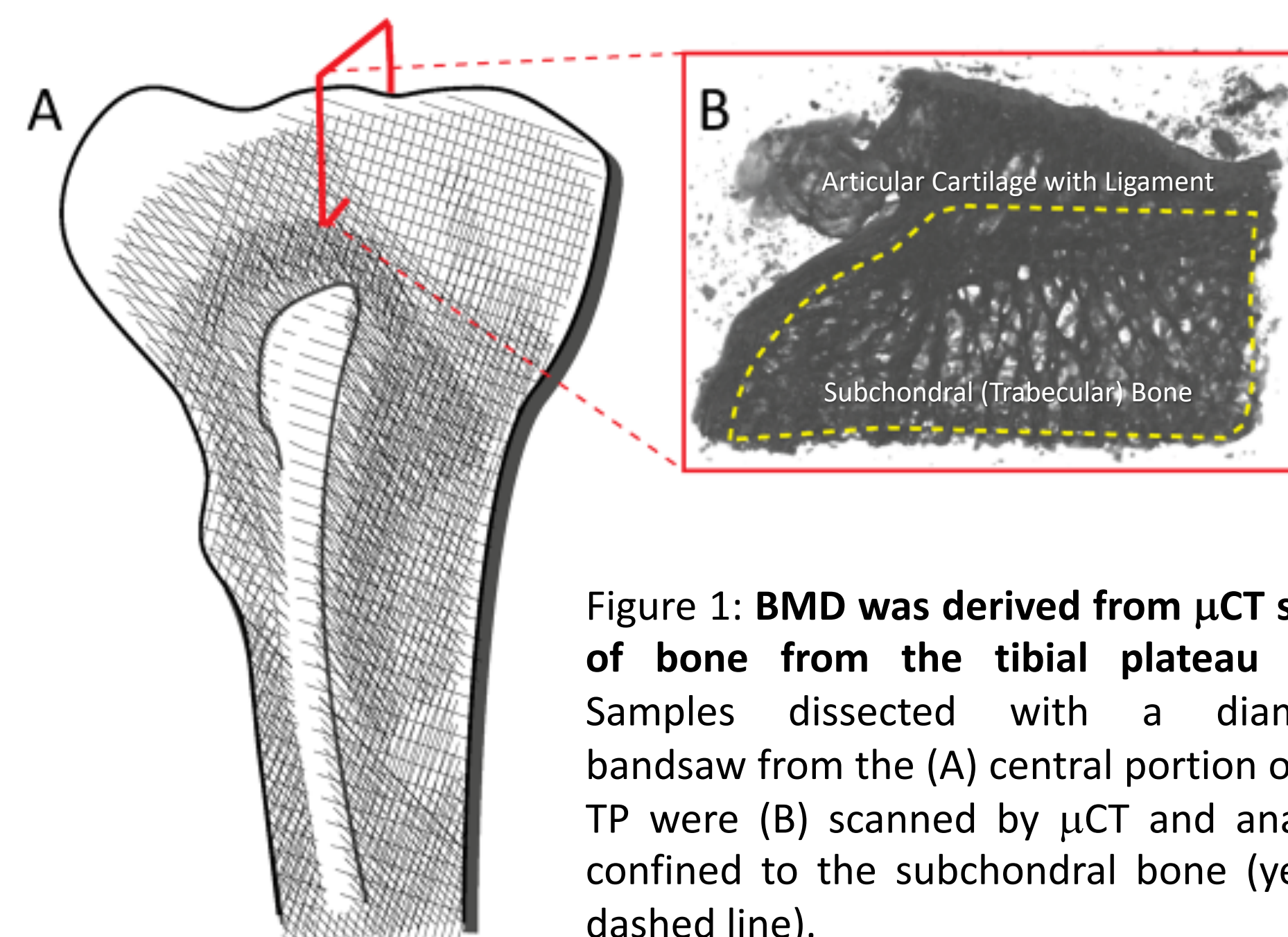


Figure 1: BMD was derived from  $\mu$ CT scans of bone from the tibial plateau (TP). Samples dissected from the (A) central portion of the TP were (B) scanned by  $\mu$ CT and analysis confined to the subchondral bone (yellow dashed line).

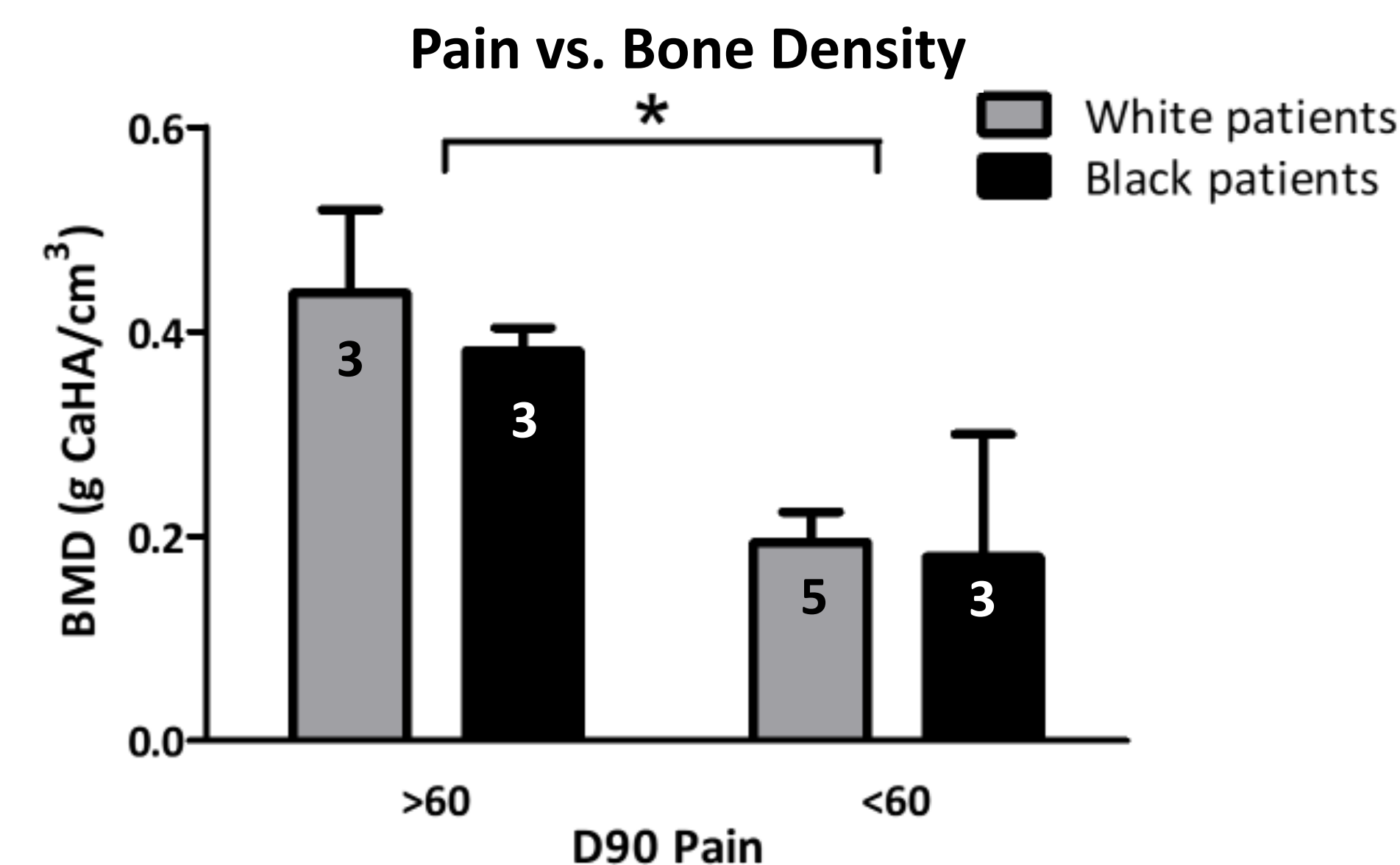


Figure 2: Women with lower BMD experience more pain post-TKA, irrespective of race. Low pain (>60) and high pain (<60) KOOS scored relative to BMD measured by  $\mu$ CT. \* =  $p < .02$  (n=14).

### Pain vs. Bone Resorption (R= -0.491, p<.01)

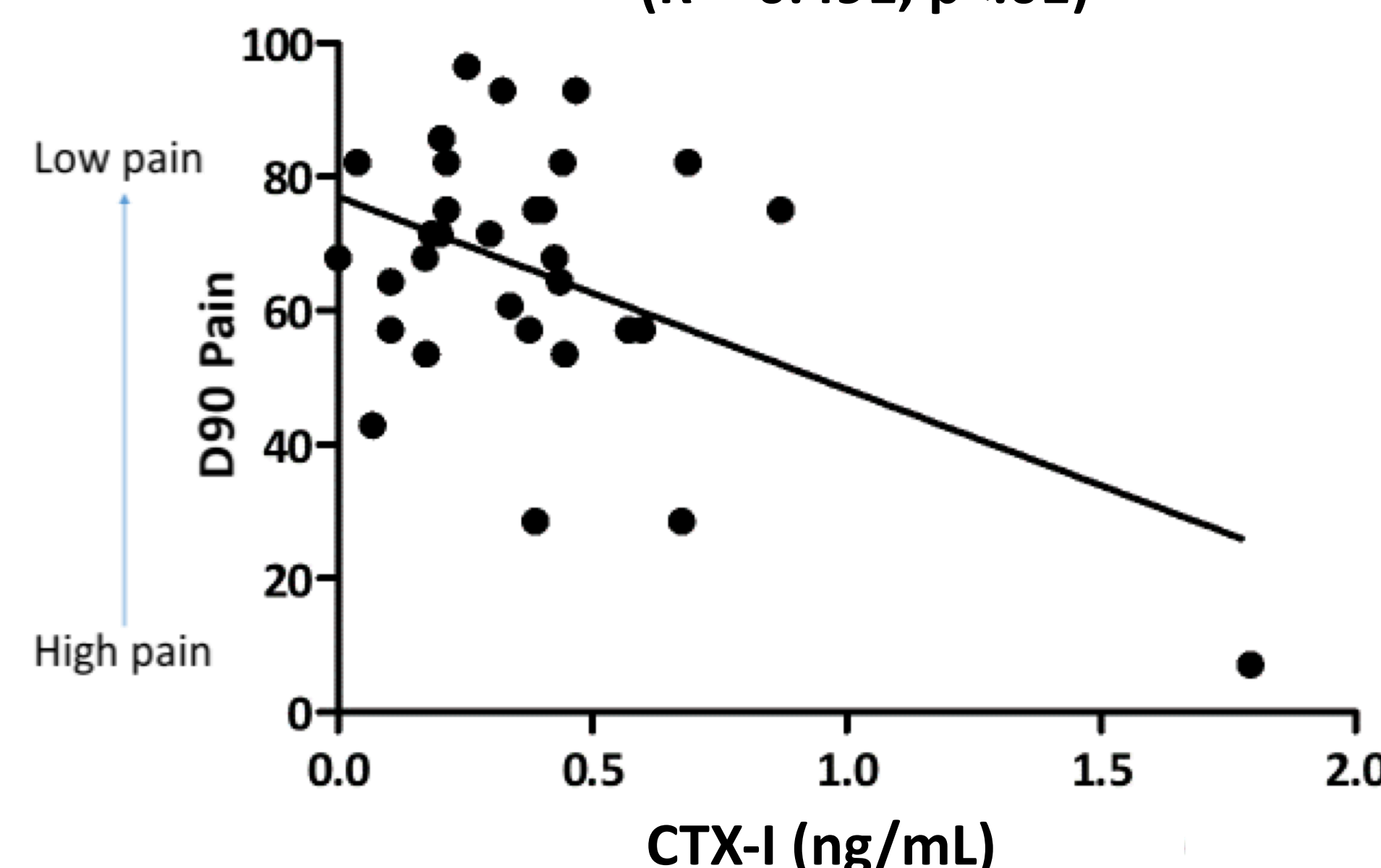


Figure 3: Higher CTX-I values indicate worse post-TKA reported pain. Moderate, inverse correlation between the CTX-I serum biomarker of bone resorption and KOOS pain subscale scores reported at 90 days post TKA (n=31).

### Pain vs. Bone Deposition (R= -.024, p=.89)

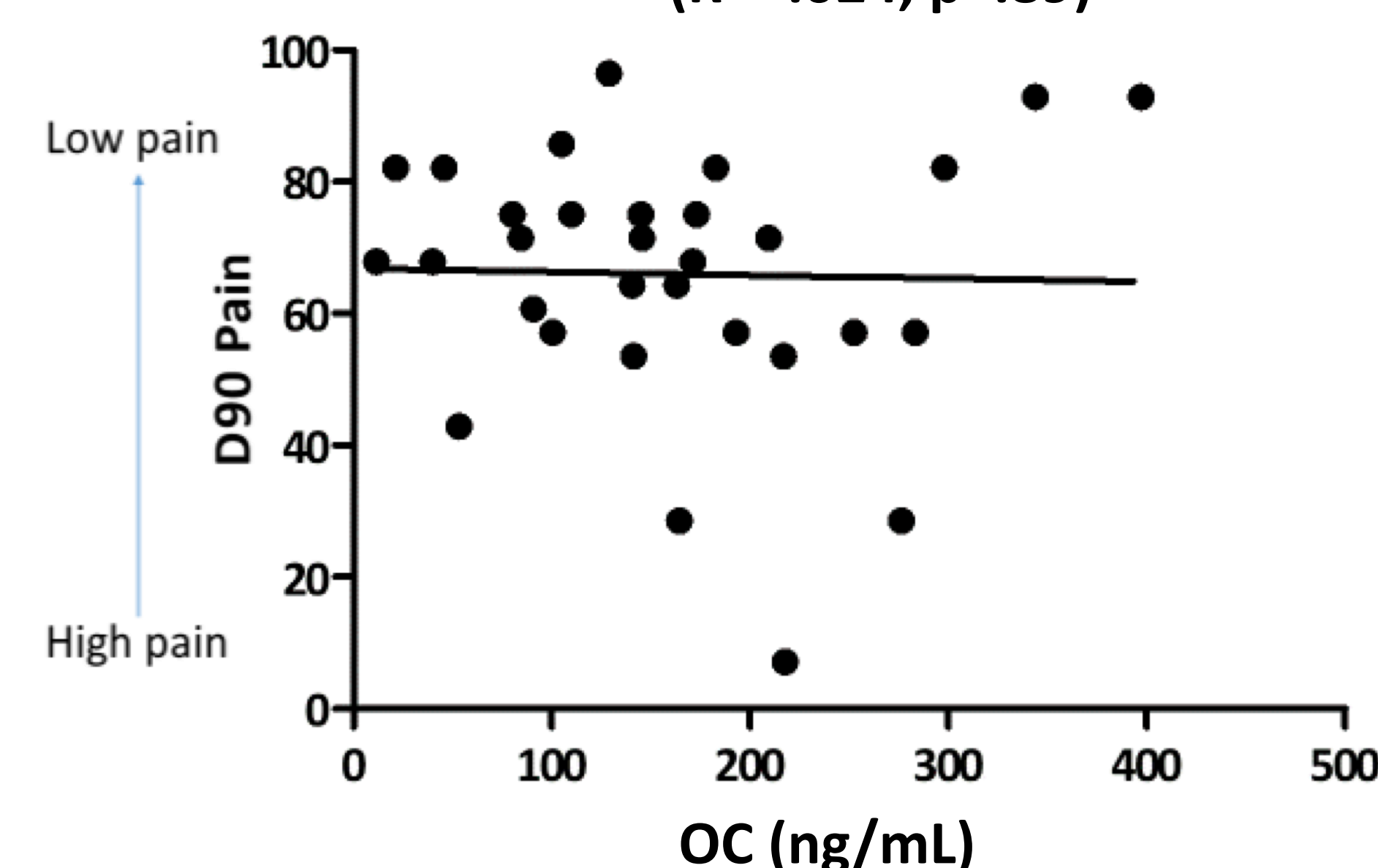


Figure 4: A systemic biomarker of bone deposition does not correlate with pain. OC secreted by bone forming osteoblasts was measured by ELISA and compared to KOOS pain scores (n=31).

### Bone Density vs. Bone Resorption (R= 0.298, p= .347)

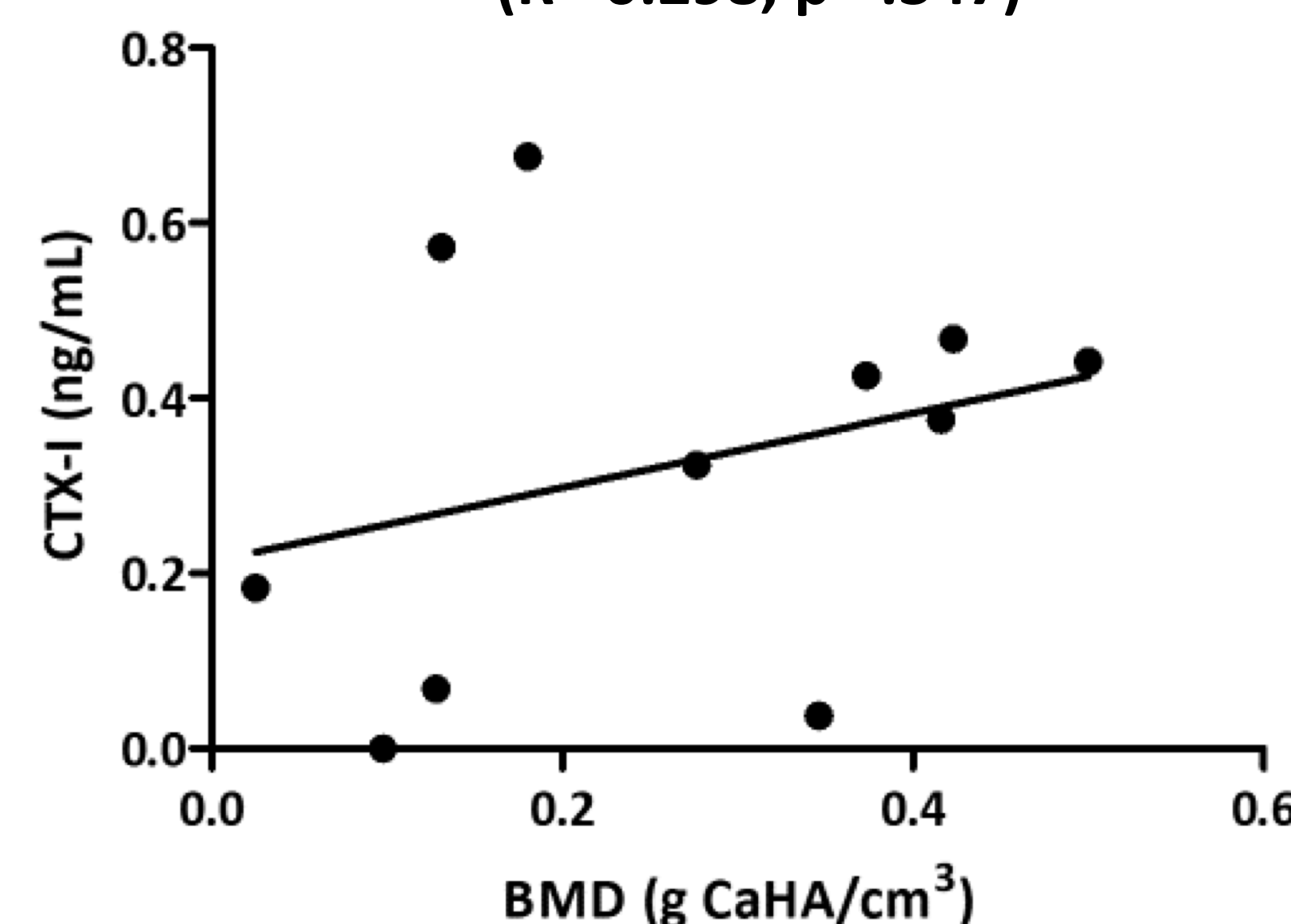


Figure 5: CTX-I alone is not a good determinant of BMD. We did not find a correlation between BMD and bone resorption, indicating that a ratio with bone formation must be calculated as a requirement to associate the dynamic process of bone turnover with BMD (n=11).

### Pain vs. Bone Density (R= 0.641, p<.02)

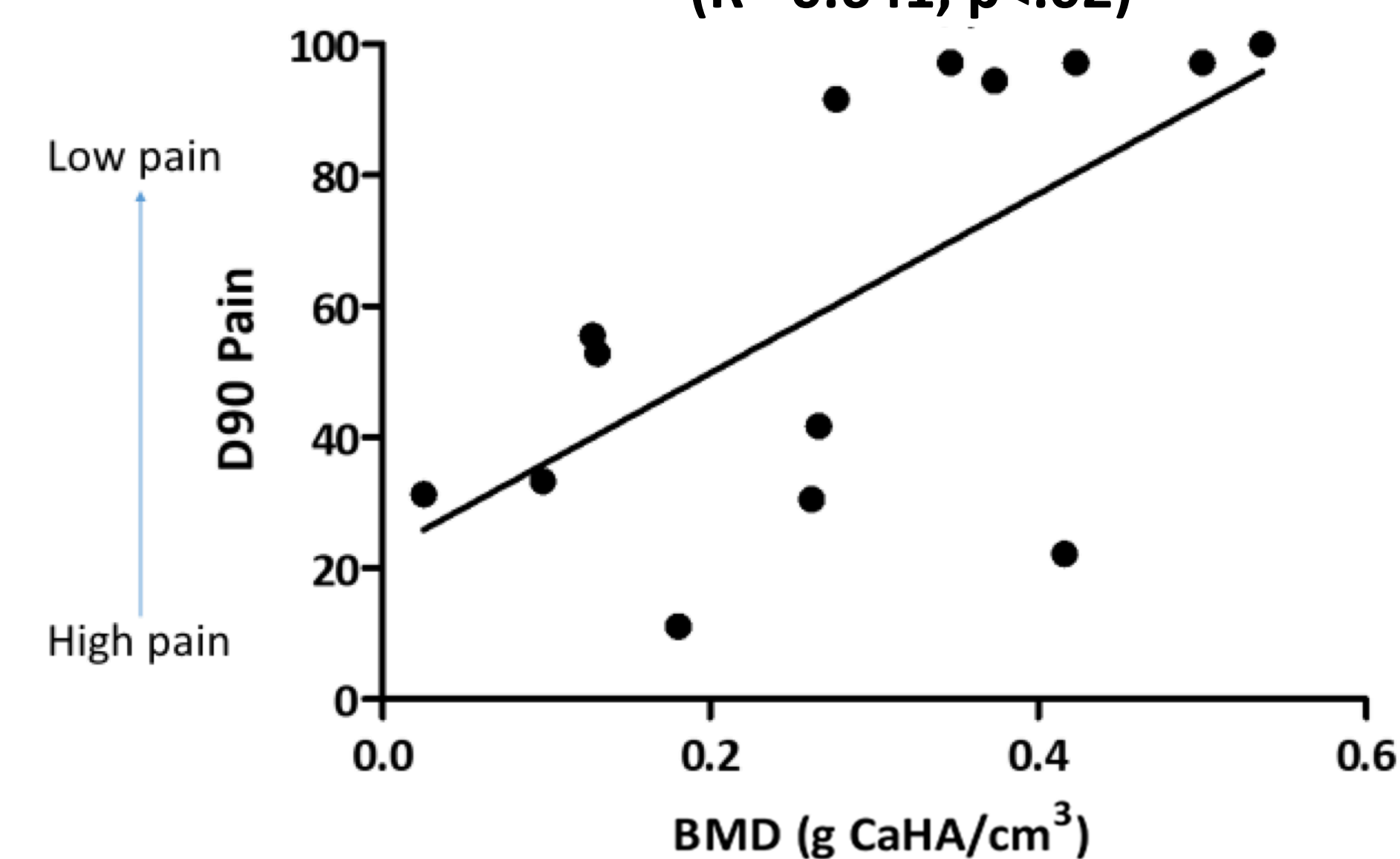
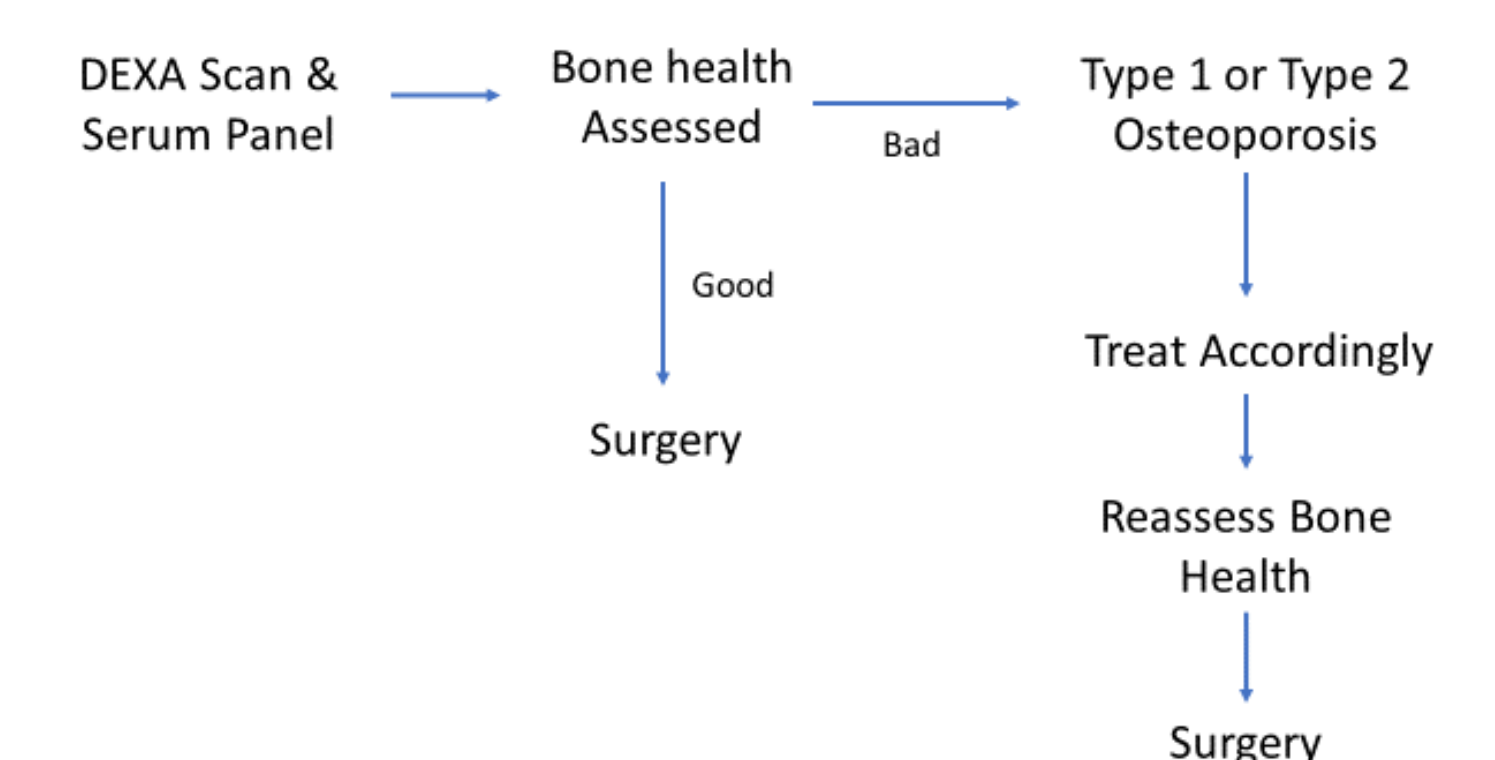


Figure 6: A lower BMD opens the possibility of experiencing worse pain after TKA. Moderately strong correlation between KOOS pain subscale scores reported at 90 days post TKA and BMD derived from  $\mu$ CT scans of the TP (n=14).

## Conclusions and Implications

- Measuring bone density prior to surgery is critical to assess those patients at higher risk for complications during joint replacement as related to compromised bone integrity and susceptibility to post-op pain.
- Together with BMD measurements by  $\mu$ CT, CTX-I can be a potential predictor of pain months after TKA. BMD can also be measured by a non-invasive DEXA scan.
- CTX-I and OC cannot be independently used to assess BMD. They must be factored together into the ratio of bone resorption to formation to derive conclusions about the overall integrity of bone health and homeostasis.
- This study highlights the advantages of screening for BMD and other measures of bone health prior to joint replacement surgery.
- Pre-operative bone health screening would allow surgeons to guide patient-specific treatments such as mitigating patient expectations, surgical alterations, or pre-surgical treatment to improve bone quality.



## Future Directions

- Increase sample size and study power
- Expand variables to include more outcome measures and other systemic or local markers of bone health
- Determine proper cutoff criteria to indicate different types of bone health
- Correlate systemic markers, DEXA scans, & surgical outcomes after factoring bone health
- Determine if racial disparities exist in the context of bone health

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