Lytic vs Sclerotic Bone Lesions: Diagnostic Accuracy of CT-guided CORE vs FNA Biopsy Techniques

Chamieh,Jad [1]; **Carpenter**,Walter [1]; **Avutu**,Bindu [1]; **Robertson**,Douglas [1,2] **Kakarala**, Aparna [1]

1. Emory Orthopedics and Spine Center, Atlanta, GA 30329
2. Georgia Institute of Technology, Department of Biomedical Engineering, Atlanta, GA

Background

- Histological diagnosis pivotal in the workup and treatment of bone lesions
- Confirmed histopathological diagnosis necessary to direct the treatment plan
- Open surgical biopsy the gold standard
  - Invasive
  - Significant seeding of tumor to surrounding tissues
  - Difficult in deep pelvic or vertebral lesions

Background

- Imaging-guided percutaneous needle biopsy
  - Lower expenses
  - Less invasive
  - Fewer complications
- Types
  - Core needle biopsy (CORE)
  - Fine Needle Aspiration (FNA)

Background

- Conflicting data concerning its diagnostic yield in both lytic and sclerotic lesions, ranging from 69% to 87.4%
- No study comparing CORE to FNA diagnostic yield on the same lesion

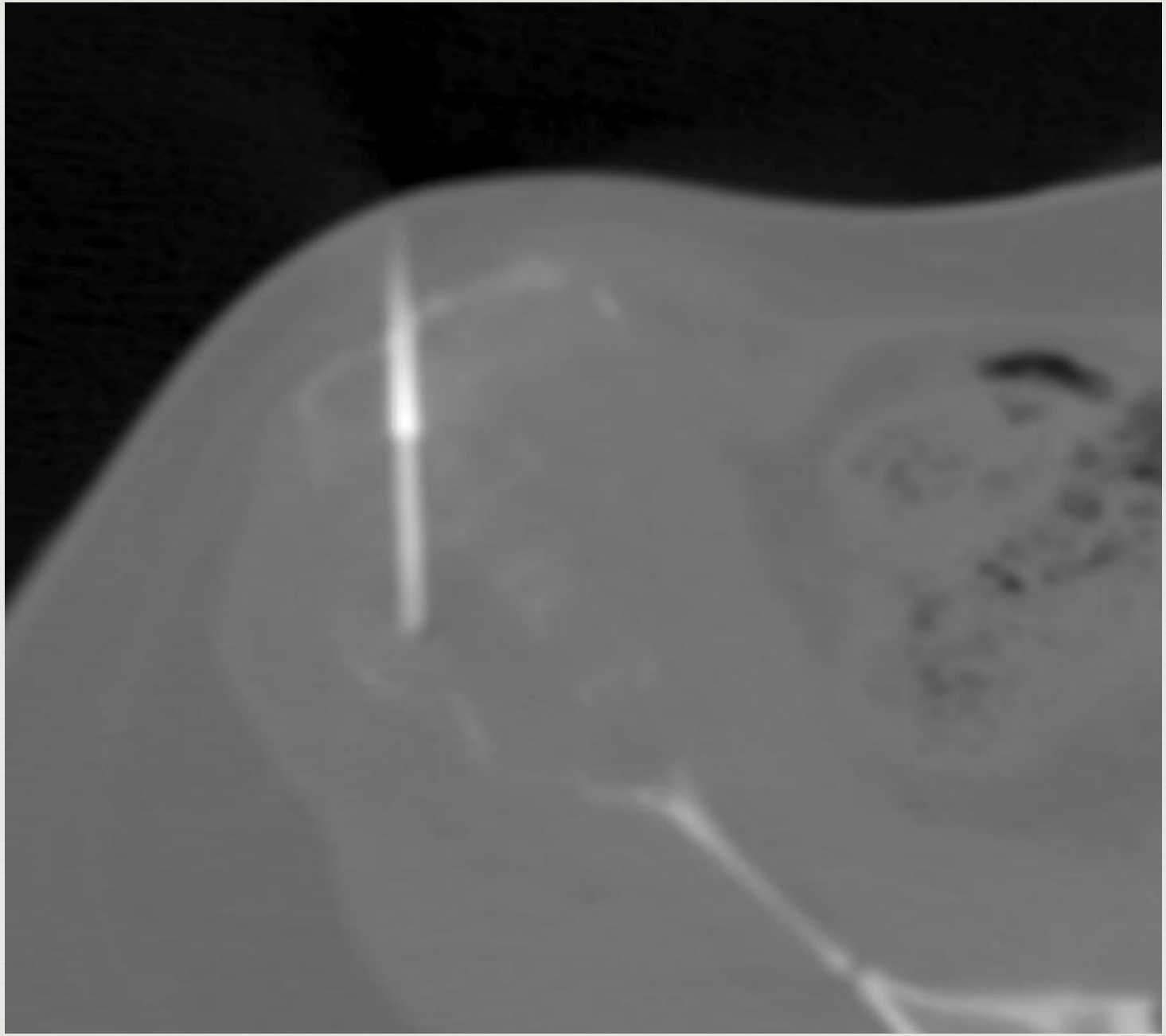
Purpose

- Test the diagnostic yield of CORE versus FNA biopsy in bone tumors
- Relate it to
  - Lesion type
  - Size
  - Location
  - Pathology

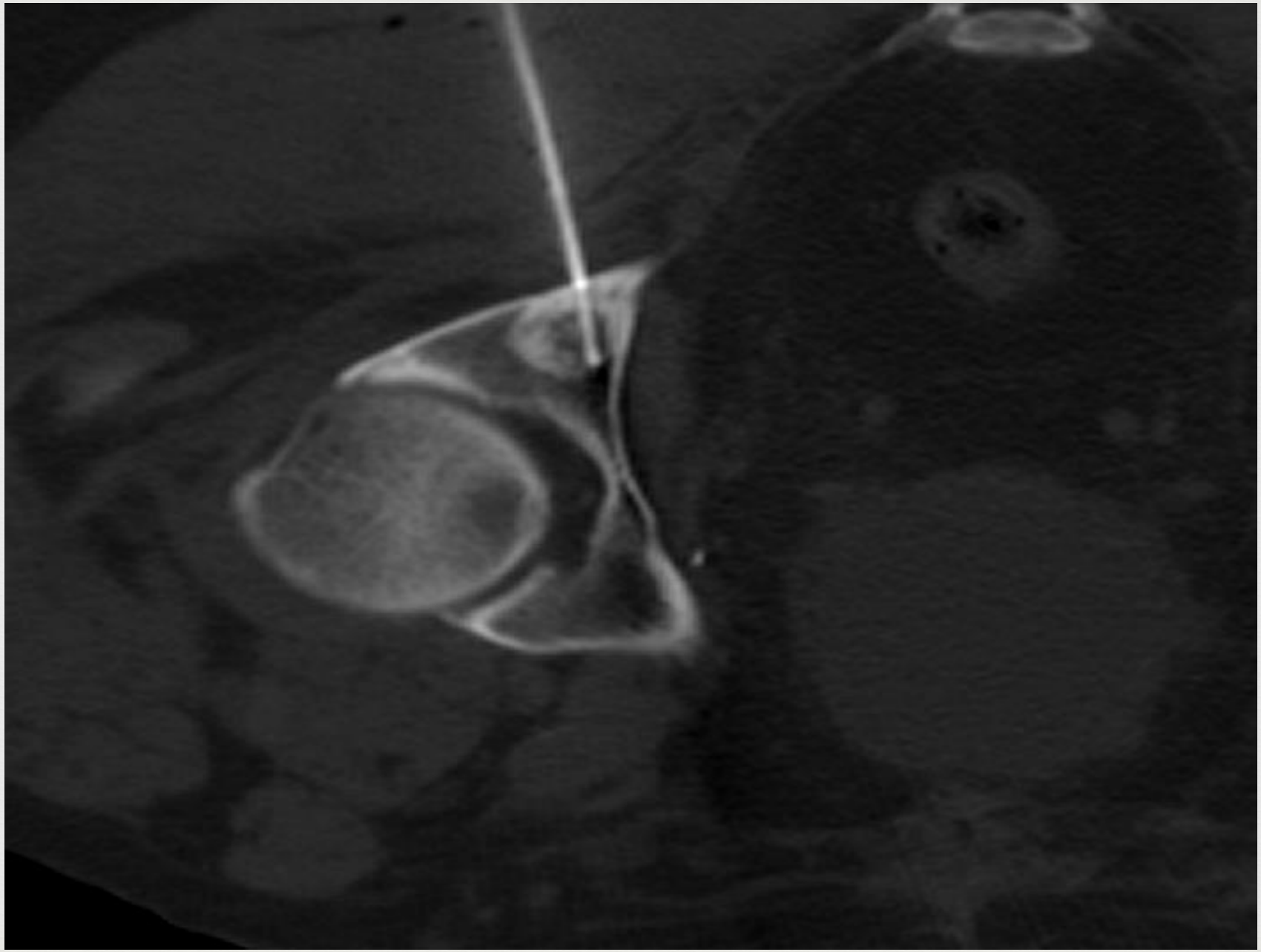
Methods

- Retrospective chart review of patients that had a CT guided CORE and/or FNA biopsy of bone performed at our institution from January 2013 to June 2014
- >70% sclerotic, considered a sclerotic lesion
- >70% lytic, classified as lytic
- Exclusion
  - Mixed lesions
  - Infections

Lytic lesion in the
Rt illeum



Sclerotic lesion Right Acetabulum



Methods

- Electronic medical records reviewed for
  - diagnostic yield
  - primary tumor
  - final surgical or pathological diagnosis
- Respective CT scans analyzed for
  - maximal lesion size in anteroposterior dimension
  - lesion type
  - skeletal location
  - type of needles used
- Repeat biopsies disregarded and their initial biopsy was considered

Methods

- Diagnostic biopsy defined as presence of adequate sample to
  - Propose a specific diagnosis
  - Deny the presence of neoplasia
- Non-diagnostic, reference neoplasia status
  - Open surgical biopsy
  - Subsequent repeat biopsy were

Methods

- CORE performed on 102 subjects
- FNA done on 76
- 64 subjects both CORE and FNA done
- 38 had CORE alone and 12 had FNA alone

Methods

- Diagnostic yield calculated for
  - CORE and FNA in common population of 64
  - CORE in all lesions were it was performed (total of 102)
  - FNA in all lesions were it was performed (total of 76)
  - Overall, CORE and/or FNA
- Subgroup analysis compared diagnostic yields of CORE versus FNA in lytic and sclerotic lesions in the common population
- Compared the diagnostic yield for CORE in neoplastic versus non-neoplastic lesions
- Similar comparisons were done for FNA

Methods

- Assessed if the type of lesion, skeletal location or gender affects overall diagnostic yield
- Pearson chi-square test or Fisher's exact test for statistical analysis
- Binary logistic regression model predicted the diagnostic yield from the combined effects of age, gender, final diagnosis, CORE or FNA used, and lesion size, type and location

Results

- 114 subjects
  - 51 females (mean age 61 years ±13.75, range 27-86)
  - 63 males (mean age 60.4 years ±13, range 19-82)
- Lesions
  - 23mm ±15 average size, range 3-71mm
  - 83 (72.8%) lytic vs 31 (27.2%) sclerotic lesions
  - 89 (78.1%) of the biopsied specimens were neoplastic
- Overall diagnostic yield 81.6%
  - 83.1% success rate for lytic lesions
  - 77.4% for sclerotic, p=0.48

Results

- Diagnostic yield
  - CORE 79.4% (where it was performed, 81 out of 102)
  - FNA 43.4% (where it was performed, 33 out of 76)
  - In cases where both were done
    - CORE was diagnostic in 81.3% (52 out of 64)
    - FNA at 32.8% (21 out of 64), p-value 0.084
- Subgroup analysis
  - CORE and FNA similar yield in lytic lesions
  - No FNA diagnostic as opposed to 71.4% for CORE (5 out of 7) in sclerotic

Results

- Overall diagnostic yield
  - Not affected by the location of the lesion
  - Significantly different between genders, p-value of 0.033
    - Females 90.2% diagnostic
    - Males 74.6% diagnostic
    - 76.2% of non-diagnostic specimens were male
    - Diagnostic biopsies equally distributed between both genders (49.5% vs 50.5%)

Results

- Lesion Nature, p-value=0.01
  - 86.5% overall diagnostic yield in neoplastic lesions
    - CORE and FNA similar, p=0.23
  - 64% in benign ones
    - Unable to compare CORE vs FNA as none of the FNA biopsies were diagnostic
- CORE diagnostic yield, p=0.025
  - 85% in neoplastic
  - 63.6% in benign
- FNA diagnostic yield, p=0.001
  - 90.5% in neoplastic
  - 53.8% in benign

Results

- Statistical model
  - Predictive of diagnostic yield
    - Gender, p=0.049
    - Neoplastic nature, p=0.018
  - Not predictive
    - Age
    - Lesion type
    - Skeletal location
    - Lesion size
    - CORE done or FNA done

Discussion

- Overall diagnostic yield of 81.6% within the range reported in literature
- Diagnostic yield for CORE biopsies 79%, almost midrange of other studies (71% to 87.5%)[1-4]
- Few studies focused on FNA results
  - Hau[5] reported 63% diagnostic yield, well above our success rate of 43.4%
  - Number reported corresponds to all musculoskeletal lesions and not restricted to bone

1. Rimondi, E., et al., *Percutaneous CT-guided biopsy of the musculoskeletal system: results of 2027 cases.* Eur J Radiol, 2011. **77**(1): p. 34-42.
2. Li, Y., et al., *Factors influencing diagnostic yield of CT-guided percutaneous core needle biopsy for bone lesions.* Clin Radiol, 2014. **69**(1): p. e43-7.
3. Omura, M.C., et al., *Revisiting CT-guided percutaneous core needle biopsy of musculoskeletal lesions: contributors to biopsy success.* AJR Am J Roentgenol, 2011. **197**(2): p. 457-61.
4. Nouh, M.R. and H.M. Abu Shady, *Initial CT-guided needle biopsy of extremity skeletal lesions: diagnostic performance and experience of a tertiary musculoskeletal center.* Eur J Radiol, 2014. **83**(2): p. 360-5
5. Hau, A., et al., *Accuracy of CT-guided biopsies in 359 patients with musculoskeletal lesions.* Skeletal Radiol, 2002. **31**(6): p. 349-53.

Discussion

- Considerably higher diagnostic yield for CORE biopsy as compared to FNA but statistically not significant
  - CORE and FNA biopsies have similar yields in lytic lesions
- No diagnostic FNA biopsies in sclerotic
  - Lesions had lytic component of possible diagnostic value

Discussion

- Eliminating confounders
  - Gender role
    - Females with better yield, also evidenced by Kattapuram[1]
    - Small sample size, p=0.049
    - Larger sample would render insignificant
  - Neoplasia
    - 22.5% improvement in overall success rates over benign lesions, p=0.01
    - CORE 21.4% better yield for neoplastic lesions, p=0.025
    - FNA 36.7% better yield for neoplastic lesions, p=0.001
    - Sufficient evidence from our study and numerous others proving the nature of the lesion largely determines a successful biopsy[2-5]

1. Kattapuram, S.V., J.S. Khurana, and D.I. Rosenthal, *Percutaneous needle biopsy of the spine.* Spine (Phila Pa 1976), 1992. **17**(5): p. 561-4.
2. Hwang, S., et al., *Percutaneous CT-guided bone biopsy: diagnosis of malignancy in lesions with initially indeterminate biopsy results and CT features associated with diagnostic or indeterminate results.* AJR Am J Roentgenol, 2011. **197**(6): p. 1417-25.
3. Omura, M.C., et al., *Revisiting CT-guided percutaneous core needle biopsy of musculoskeletal lesions: contributors to biopsy success.* AJR Am J Roentgenol, 2011. **197**(2): p. 457-61.
4. Hau, A., et al., *Accuracy of CT-guided biopsies in 359 patients with musculoskeletal lesions.* Skeletal Radiol, 2002. **31**(6): p. 349-53.
5. Virayavanich, W., et al., *CT-guided biopsy of bone and soft-tissue lesions: role of on-site immediate cytologic evaluation.* J Vasc Interv Radiol, 2011. **22**(7): p. 1024-30.

Discussion

- No effect of lesion type on diagnostic yield
  - 83.1% lytic compared to 77.4% sclerotic, p=0.48
  - Wu et al: 87% lytic compared to 57% sclerotic, p=0.002[1]
  - Li's et al: 90% lytic compared to 48.5% sclerotic, p<0.001[2]
- No effect for lesion location on diagnostic yield
  - 78.9% appendicular compared to 84.2% axial, p>0.4
  - Omura et al: confirmed our results, with 70% success rate vs 75% and p=0.36[3]

1. Wu, J.S., et al., *Bone and soft-tissue lesions: what factors affect diagnostic yield of image-guided core-needle biopsy?* Radiology, 2008. **248**(3): p. 962-70.
2. Li, Y., et al., *Factors influencing diagnostic yield of CT-guided percutaneous core needle biopsy for bone lesions.* Clin Radiol, 2014. **69**(1): p. e43-7
3. Omura, M.C., et al., *Revisiting CT-guided percutaneous core needle biopsy of musculoskeletal lesions: contributors to biopsy success.* AJR Am J Roentgenol, 2011. **197**(2): p. 457-61.

Discussion

- On-site immediate cytological assessment
  - Virayavanich et al: success rates improved by 14%[1]
  - Tsou et al: improved yield by 3.8% for lung and 9.5% for nonpulmonary lesions[2]
- Goal of on-site assessment
  - Not to provide a diagnosis
  - Inform the radiologist of adequacy of specimen retrieval

1. Virayavanich, W., et al., *CT-guided biopsy of bone and soft-tissue lesions: role of on-site immediate cytologic evaluation.* J Vasc Interv Radiol, 2011. **22**(7): p. 1024-30.
2. Tsou, M.H., et al., *CT-guided needle biopsy: value of on-site cytopathologic evaluation of core specimen touch preparations.* J Vasc Interv Radiol, 2009. **20**(1): p. 71-6.

Weakness

- Retrospective study
- Only one of our FNA biopsies was diagnostic while CORE was not
- No sclerotic FNA biopsies were diagnostic
- No FNA was diagnostic in benign lesions
  - Unable to compare the yield of CORE to FNA in non-neoplastic lesions

Conclusion

- First study to compare diagnostic yield of CORE to FNA biopsies when both were performed on the same lesion
- 48.5% better yield with CORE than FNA however we observed only a nearly significant p-value
- Neoplastic lesions with better yield with either modality than benign ones, corroborating previous literature

Recommendations

- Immediate on-site cytological assessment
  - If available
    - FNA should be attempted first
    - Checked for the adequacy of tissue retrieval
  - If unavailable
    - Proceed directly with CORE biopsy due to its proven precision in providing an adequate tissue sample

References

1. Huang, A.J. and S.V. Kattapuram, *Musculoskeletal neoplasms: biopsy and intervention.* Radiol Clin North Am, 2011. **49**(6): p. 1287-305, vii.
2. Balach, T., G.S. Stacy, and T.D. Peabody, *The clinical evaluation of bone tumors.* Radiol Clin North Am, 2011. **49**(6): p. 1079-93, v.
3. Pramesh, C.S., et al., *Core needle biopsy for bone tumours.* Eur J Surg Oncol, 2001. **27**(7): p. 668-71.
4. Avedian, R.S., *Principles of musculoskeletal biopsy.* Cancer Treat Res, 2014. **162**: p. 1-7.
5. Rimondi, E., et al., *Percutaneous CT-guided biopsy of the musculoskeletal system: results of 2027 cases.* Eur J Radiol, 2011. **77**(1): p. 34-42.
6. Khoja, H., et al., *Sampling modality influences the predictive value of grading in adult soft tissue extremity sarcomas.* Arch Pathol Lab Med, 2013. **137**(12): p. 1774-9.
7. Li, Y., et al., *Factors influencing diagnostic yield of CT-guided percutaneous core needle biopsy for bone lesions.* Clin Radiol, 2014. **69**(1): p. e43-7.
8. Pohlig, F., et al., *Percutaneous core needle biopsy versus open biopsy in diagnostics of bone and soft tissue sarcoma: a retrospective study.* Eur J Med Res, 2012. **17**: p. 29.
9. Skrzynski, M.C., et al., *Diagnostic accuracy and charge-savings of outpatient core needle biopsy compared with open biopsy of musculoskeletal tumors.* J Bone Joint Surg Am, 1996. **78**(5): p. 644-9.
10. Wu, J.S., et al., *Bone and soft-tissue lesions: what factors affect diagnostic yield of image-guided core-needle biopsy?* Radiology, 2008. **248**(3): p. 962-70.
11. Hwang, S., et al., *Percutaneous CT-guided bone biopsy: diagnosis of malignancy in lesions with initially indeterminate biopsy results and CT features associated with diagnostic or indeterminate results.* AJR Am J Roentgenol, 2011. **197**(6): p. 1417-25.
12. Omura, M.C., et al., *Revisiting CT-guided percutaneous core needle biopsy of musculoskeletal lesions: contributors to biopsy success.* AJR Am J Roentgenol, 2011. **197**(2): p. 457-61.
13. Hau, A., et al., *Accuracy of CT-guided biopsies in 359 patients with musculoskeletal lesions.* Skeletal Radiol, 2002. **31**(6): p. 349-53.
14. Nouh, M.R. and H.M. Abu Shady, *Initial CT-guided needle biopsy of extremity skeletal lesions: diagnostic performance and experience of a tertiary musculoskeletal center.* Eur J Radiol, 2014. **83**(2): p. 360-5.
15. Yang, Y.J. and T.A. Damron, *Comparison of needle core biopsy and fine-needle aspiration for diagnostic accuracy in musculoskeletal lesions.* Arch Pathol Lab Med, 2004. **128**(7): p. 759-64.
16. Ray-Coquard, I., et al., *Evaluation of core needle biopsy as a substitute to open biopsy in the diagnosis of soft-tissue masses.* European Journal of Cancer, 2003. **39**(14): p. 2021-2025.
17. Kattapuram, S.V., J.S. Khurana, and D.I. Rosenthal, *Percutaneous needle biopsy of the spine.* Spine (Phila Pa 1976), 1992. **17**(5): p. 561-4.
18. Virayavanich, W., et al., *CT-guided biopsy of bone and soft-tissue lesions: role of on-site immediate cytologic evaluation.* J Vasc Interv Radiol, 2011. **22**(7): p. 1024-30.
19. Tsou, M.H., et al., *CT-guided needle biopsy: value of on-site cytopathologic evaluation of core specimen touch preparations.* J Vasc Interv Radiol, 2009. **20**(1): p. 71-6.
20. Kattapuram, S.V. and D.I. Rosenthal, *Percutaneous biopsy of the cervical spine using CT guidance.* AJR Am J Roentgenol, 1987. **149**(3): p. 539-41.