

Diagnostic performance, interobserver agreement and predictive value of individual MUSA sonographic features for adenomyosis: a multi-observer study

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Introduction

Adenomyosis is characterised by the presence of ectopic endometrial glands and stroma within the myometrium and is associated with dysmenorrhoea, abnormal uterine bleeding, pelvic pain and adverse reproductive outcomes. Histological examination of a hysterectomy specimen remains the reference standard for diagnosis; however, transvaginal ultrasound (TVUS) provides a non-invasive and widely accessible alternative. The diagnostic performance of TVUS for adenomyosis varies considerably between studies, reflecting differences in diagnostic criteria and interpretation. The Morphological Uterus Sonographic Assessment (MUSA) consensus criteria were developed to standardise the terminology and reporting of sonographic features of adenomyosis. The revised MUSA criteria include nine sonographic features comprising direct and indirect signs. Despite increasing use of MUSA terminology, validation of the revised criteria remains limited, and the reproducibility and diagnostic value of individual features are uncertain.

Aim

To evaluate the:
Diagnostic performance of individual MUSA sonographic features for adenomyosis using histology as the reference standard.
Interobserver agreement for the diagnosis of adenomyosis and individual MUSA features.
Predictive value of individual MUSA features for histological adenomyosis.

Methods

Study design and population
A multi-observer diagnostic accuracy study was performed using ultrasound examinations from **62 women** with histological assessment of adenomyosis. Five observers with varying levels of ultrasound experience independently assessed the ultrasound examinations:
Observers 1–2: Senior
Observers 3–4: Intermediate
Observer 5: Junior
Ultrasound examinations consisted of either still image captures or video clips.
Ultrasound assessment
Observers assessed the presence or absence of adenomyosis and individual MUSA sonographic features (figure 1).
Statistical analysis

Diagnostic accuracy, sensitivity and specificity were assessed using histology as the reference standard. Interobserver agreement was assessed using **Fleiss' kappa** for multiple observers and pairwise kappa coefficients. Mixed-effects logistic regression was used to assess the association between individual MUSA features and histological adenomyosis while accounting for repeated observations by individual observers.

Results and Discussion

Diagnostic Performance
Overall diagnostic accuracy: 61.3–72.1%, **Mean diagnostic accuracy:** 66.5%
High sensitivity, lower specificity suggests a tendency towards **overdiagnosis of adenomyosis on ultrasound**
Interobserver Agreement
Overall agreement: Fleiss’ $\kappa = 0.18 \rightarrow$ slight agreement
Pairwise agreement: $\kappa = 0.10\text{--}0.34$
No observer pair demonstrated moderate or substantial agreement
Translesional vascularity: greatest interobserver agreement
Irregular junctional zone: highest diagnostic accuracy
Hyperechogenic islands: almost no interobserver agreement despite moderate diagnostic accuracy
No individual MUSA feature independently predicted histological adenomyosis

Conclusion

- TVUS demonstrated **moderate diagnostic accuracy but poor interobserver agreement**
- Diagnostic accuracy and reproducibility **varied substantially between individual MUSA features**
- No individual MUSA feature independently predicted histological adenomyosis**
- Findings support further evaluation of:
 - Feature-weighted diagnostic models**
 - Integration of clinical symptoms + ultrasound findings**
 - Improved non-invasive diagnosis of adenomyosis**

References

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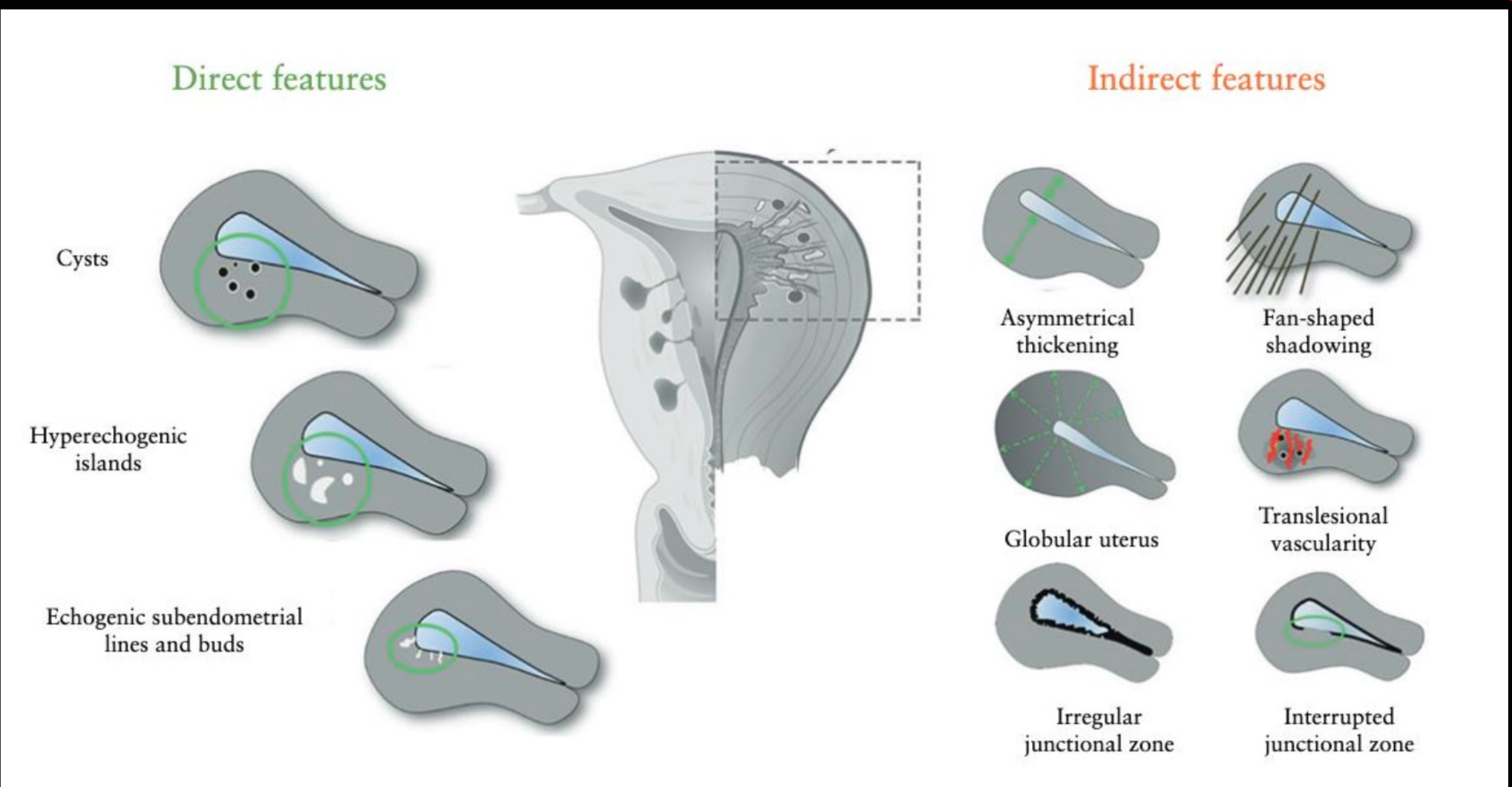


Figure 1. The Revised MUSA criteria

Characteristic	Result
Total participants	62
Age, mean ± SD	43.5 ± 8.1 years
Age, median (IQR)	42.5 (39–48) years
Age range	32–82 years
Histological adenomyosis	45 (72.6%)
No histological adenomyosis	17 (27.4%)
Pelvic pain	36 (58.1%)
Heavy menstrual bleeding	31 (50.0%)
Still images	32 (51.6%)
Video clips	30 (48.4%)

Diagnostic meas	Range across observ
Accuracy	61.3–72.1%
Sensitivity	68.2–90.9%
Specificity	17.6–62.5%

Figure 3. Overall diagnostic accuracy

Figure 2. Demographic characteristics

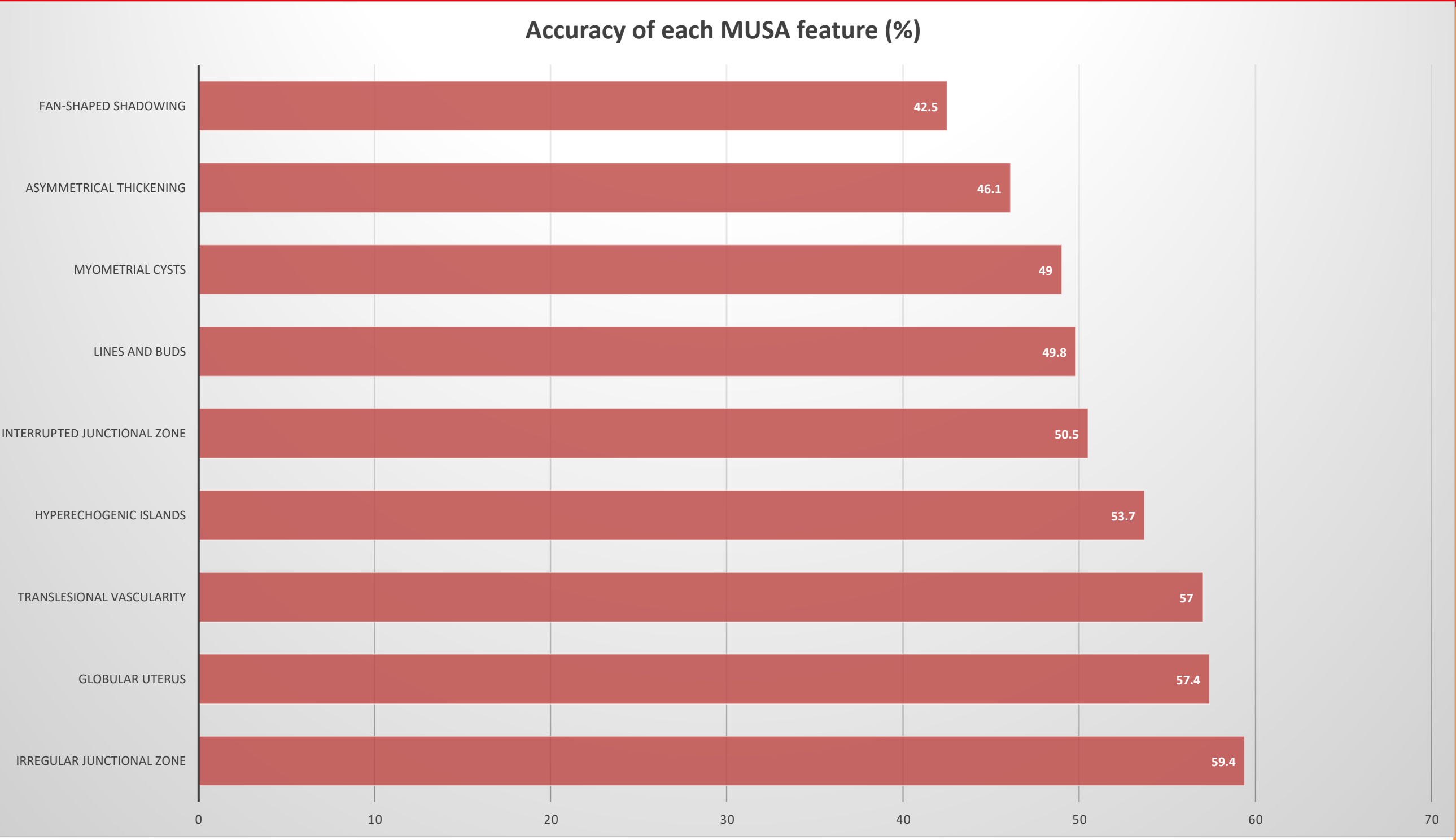


Figure 4. Diagnostic accuracy by MUSA feature