Recommendations/guidelines issued by SPIWG
MRI of the scrotum

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MRI of the scrotum

- MRI is becoming established as a worthwhile second-line diagnostic tool for scrotal pathology

- SPIWG has recently produced recommendations for MRI of the scrotum
  - acquisition protocols
  - clinical indications
Methods

- original and review articles, published before September 2016
- English-language literature, studies on human subjects, Pubmed and Medline databases
- Keywords: ‘magnetic resonance imaging’, 'testis or testicle or testicular', 'scrotum', 'intratesticular', 'paratesticular', 'extratesticular', 'diffusion-weighted' and 'dynamic MRI'
- consensus obtained through discussions at international congresses, by e-mail and when necessary, supplemented by the combined expertise of the multinational group

- Grade A: consistent LE1 studies; Grade B: consistent LE2 or LE3 studies or extrapolations from LE1 studies; Grade C: LE4 studies or extrapolations from LE2 or LE3 studies; and Grade D: LE5 studies or troubling inconsistent or inconclusive studies of any level
Technical requirements

- **Coil selection**

- surface coils are recommended *(LE2, Grade B)*

- phased-array coils also provide diagnostic information *(LE2, Grade B)*. Phased-array coils may also be used to evaluate the abdomen and pelvis for staging testicular malignancies.
Technical requirements

- Patient preparation and positioning

- adequate support and correct positioning of the scrotum is essential (LE2, Grade B)
  - supine position
  - feet first
  - both testes placed at a similar distance from the
  - penis draped on the anterior abdominal wall
Conventional (anatomical imaging)

- at least two orthogonal planes, along the testicular length and transverse axes
- coronal and axial plane is recommended
- axial T1WI is recommended (LE2, Grade B)
- T2WI in at least two planes: axial and coronal (LE2, Grade B)
- TE of 100–140 ms (LE2)
- sagittal T2WI: optional, recommended for: evaluation of the epididymis, lesion localization, depiction of small-sized lesions close to the anterior or posterior testicular surfaces (LE4), testicular rupture (L32), and local staging of testicular carcinomas (LE2)
- fat-saturated T1WI and fat-saturated T2WI: as alternatives (LE4, Grade B)
- T2*-weighted gradient-echo sequence: acute scrotum (LE2, Grade B)
- thin sections: 3-4 mm, no gap
- 2.5 mm without gap for very small testes
- FOV: 10-28cm
- superior and inferior saturation bands
DWI

- DWI is recommended in the evaluation of scrotal pathology (LE2, Grade B)
  - axial plane
  - echo planar diffusion pulse sequence
  - at least three $b$ values: 0, 400-500 and 800-1,000 s/mm$^2$
  - high $b$ value (800–1,000) DWI + ADC maps, in combination with T1WI and T2WI
DCE-MRI

- Subtracted DCE-MRI is recommended in the evaluation of scrotal diseases (Grade B)
  - characterization of scrotal lesions (LE2)
  - acute scrotum (LE2)

- Conventional CE T1WI may be used as an alternative (Grade C)
DCE-MRI-protocol

- subtraction DCE-MRI is recommended (LE2)
  - coronal plane
  - series of 3D fast field-echo sequences
  - bolus injection (1–2 ml/s) of gadolinium-based contrast medium, within 5 s, 20 ml of physiological saline
  - 5-7 imaging sets, 15 s after the injection of contrast material
  - duration of each set: 50-60 s
  - total examination time: 8 min
  - slice-by-slice subtraction using the data set obtained immediately before iv administration as a mask
DCE-MRI

- types of contrast enhancement patterns: differentiation of testicular lesions

  - **type I**: gradual linear increase of enhancement throughout the examination of normal testis
  - **type II**: brisk upstroke enhancement, followed by either a plateau or a slight further increase in enhancement of benign lesions
  - **type III**: brisk enhancement, followed by gradual washout of the contrast medium of malignancies
  - **type 0**: little or no enhancement
Clinical indications: Lesion localization

- MRI is recommended when differentiation between intratesticular and paratesticular masses is not possible, based on US findings (LE4, Grade C)

- rarely needed

- US: initial imaging modality

- when the exact location is uncertain with US, MRI may be helpful
  - especially in differentiating masses arising from the tunica albuginea rather than from the peripheral seminiferous tubules

- MRI protocol: should T2WI in three planes
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- MRI protocol: should T2WI in three planes
Adenomatoid tumor attached to the visceral layer of tunica vaginalis
Lesion characterization: Intratesticular masses
Benign vs malignant

- MRI is recommended as a second-line technique for characterization of intratesticular masses, in patients with equivocal US findings (Grade C)

  ✓ confident characterization of the benign nature of intratesticular masses
  ✓ important information in the preoperative characterization of the histological nature of various benign intratesticular mass lesions in terms of morphological information and by showing the presence of fat, fluid, hemorrhage, fibrous tissue and solid contrast-enhancing tissue (LE2)
  ✓ decrease the number of unnecessary radical surgical procedures
Testicular fibrosis
Intratesticular hematoma
Lesion characterization: Germ cell neoplasms versus non-germ cell neoplasms

<table>
<thead>
<tr>
<th>MRI findings of TGCNs</th>
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<tbody>
<tr>
<td><strong>Primary</strong></td>
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<tr>
<td>• mainly isointense on T1WI</td>
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<tr>
<td>• low or heterogeneous T2 signal</td>
</tr>
<tr>
<td>• restricted diffusion, low ADC</td>
</tr>
<tr>
<td>• heterogeneous enhancement</td>
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<tr>
<td>• type III TSI curve</td>
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NSGCN (teratoma, embryonal carcinoma and yolk sac tumor in a 20-year old man)
Lesion characterization: Germ cell neoplasms versus non-germ cell neoplasms

- MRI may help in the characterization of LCTs (LE2, Grade B, work in progress)

- Widespread use of US: increase of incidentally discovered nonpalpable small solid testicular masses
- 80%: benign, LCTs: most frequent
- Testis-sparing surgery (TSS): recommended for small LCTs
Lesion characterization: Germ cell neoplasms versus non-germ cell neoplasms

- TSS: recommended in small-sized Sertoli cell tumours

- no adequate data on MRI findings

- **MRI findings suggestive of the diagnosis of primary testicular lymphoma**: hypointense T2 mass, strongly and heterogeneously enhancing, >60 years of age (**LE4**)
Primary testicular lymphoma
Lesion characterization: Seminomas versus nonseminomatous tumours

- MRI is recommended to differentiate seminomas from nonseminomatous testicular germ cell neoplasms in selected cases (Grade C)

- In cases of disseminated disease and/or life-threatening complications, where chemotherapy is the first treatment

- MRI features: closely correlate with the histopathological characteristics of TGCNs (LE4)

- ADC: additional tool for differential diagnosis (LE4)
# MRI findings to differentiate seminomas from nonseminomas

<table>
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<tr>
<th>Seminomas</th>
<th>Nonseminomas</th>
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<tr>
<td>• multinodular</td>
<td>• often surrounded by a low signal intensity halo (proved to correspond to fibrous capsule on pathology)</td>
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<tr>
<td>• mainly isointense on T1WI</td>
<td>• heterogeneous on T1WI</td>
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<tr>
<td>• relatively homogenous and hypointense on T2WI</td>
<td>• markedly heterogeneous on T2WI</td>
</tr>
<tr>
<td>• bandlike structures of low T2 signal (corresponding to fibrovascular septa on pathology)</td>
<td>• heterogeneous enhancement</td>
</tr>
<tr>
<td>• septa enhancing more that the remaining tumour</td>
<td></td>
</tr>
<tr>
<td>• lower ADC, compared to nonseminomas</td>
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Seminoma in a 43-year old man
NSGCN (teratocarcinoma) in a 26-year old man invading the tunica albuginea
Lesion characterization: Paratesticular masses

- MRI is recommended for characterization of paratesticular masses (LE4, Grade C)
  - primary solid tumours of the paratesticular space: usually benign
  - confident characterization may obviate unnecessary radical orchiectomy
  - US findings: often overlap
Lesion characterization: Paratesticular masses

- **MRI findings**
  - tumour location
  - morphological findings
  - tissue characteristics

- **MRI: malignancies**
  - diagnosis of aggressive neoplasm
  - local extent
  - distant metastases

- **MRI protocol:** should include T2WI in three planes
Fibrous pseudotumor
Local staging of TGCTs

- MRI is recommended for local staging of TGCNs (Grade C)
- in patients candidates for testis-sparing surgery

**MRI information**

- preoperative evaluation of the local stage T
- tumour dimensions
- possible invasion of rete testis, paratesticular space and/or spermatic cord
- presence of a pseudocapsule (LE4)

**MRI protocol:** should include T2WI in all three planes
NSGCN (teratocarcinoma, yolk sac tumor, seminoma) in a 45-year old man, pT2
Acute scrotum

- MRI is recommended as a complimentary examination in acute scrotal diseases (LE2, Grade B)

- rarely needed

- **recommended:** inconclusive US findings, incomplete testicular torsion, referred with delayed torsion, or as a confirmatory study, for appropriate treatment planning (LE2)

- **MRI protocol:** + T2*WI in cases of absent or diminished enhancement by the affected testis
Scrotal trauma

- MRI is recommended as a second-line imaging examination in cases of scrotal trauma and non-diagnostic US findings (LE2, Grade B)

- accurate characterization of the type of blunt scrotal trauma is mandatory: appropriate treatment can be planned

- US: first-line diagnostic tool

- MRI protocol: should include T2WI in three planes
Undescended testes

- MRI is recommended for locating nonpalpable undescended testes (LE2, Grade B)

- **US**: does not always reliably localize nonpalpable undescended testes and does not rule out an intra-abdominal testis

- **MRI πρωτόκολλο**: axial T1WI, axial and coronal fat-suppressed T2WI, **DWI (work in progress)**. In cases of intra-abdominal testis, coverage extended to the lower poles of kidneys
MRI of the scrotum, including a multiparametric protocol, represents a valuable and efficient supplemental imaging technique in the evaluation of scrotal pathology. MRI protocol should include T1WI, T2WI, DWI and subtracted DCE-MRI. Scrotal MRI can be clinically applied for:

- Lesion characterization (primary), including both intratesticular and paratesticular masses.
- Differentiation between germ-cell and non-germ-cell neoplasms (evolving).
- Characterization of the histological type of TGCNs (in selected cases).
- Local staging of TGCNs (primary).
- Acute scrotum (in selected cases).
- Trauma (in selected cases).
- Undescended testes (primary).