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## Role of Magnetic resonance imaging in diagnosis, staging and follow up of patients with carcinoma cervix

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### Abstract

**Background and Aim:** Carcinoma cervix is the most common gynaecological cancer in India and the second most common cancer worldwide. The current system of staging cervical carcinoma is based on International Federation of Gynaecology and Obstetrics (FIGO) Classification. The aim of this study was to evaluate the efficacy of Magnetic Resonance Imaging in staging and assessment of important prognostic factors in carcinoma cervix. And also to correlate Magnetic Resonance Imaging findings with clinical staging in carcinoma cervix patients.

**Materials and Methods:** From June 2017 to June 2018, 70 patients (both new and treated) who were histopathologically diagnosed cases of carcinoma cervix and referred to the Department of Radiodiagnosis, Coimbatore Medical College were included in the study.

**Results:** In our study, T2 Weighted Imaging in combination with Diffusion Weighted Imaging was the most valuable sequence in both new and treated cases. Contrast enhanced Magnetic Resonance Imaging provided no added information. Size of mass lesion, uterine body involvement and nodal metastasis were important prognostic factors that were assessed better using Magnetic Resonance Imaging. The accuracy, sensitivity, positive and negative predictive values of Magnetic Resonance Imaging in newly diagnosed cases were 88.19%, 88%, 92.59% and 95.65% respectively. Post radiation complications which were common after 2-3 years of radiotherapy was better evaluated with Magnetic Resonance Imaging.

**Conclusion:** Magnetic Resonance Imaging scored better than clinical techniques and other imaging methods in staging of carcinoma cervix and assessing its recurrence. Hence, Magnetic Resonance Imaging can be used as a single best investigation for local staging in carcinoma cervix, obviating the need for multiple invasive procedures.

**Keywords:** carcinoma cervix, FIGO, Diffusion Weighted Imaging, post radiation

### 1. Introduction

Carcinoma cervix is the most common gynaecological cancer in India and the second most common cancer worldwide. It predominantly affects multiparous women. Incidence of carcinoma cervix rises from 30-34 years and peaks at 50-55 years. The prevalence of cervical carcinoma has increased in recent years due to early screening programs.

The current system of staging cervical carcinoma is based on International Federation of Gynaecology and Obstetrics (FIGO) Classification. This staging system is based upon findings from examination of patient under anaesthesia supplemented by radiography, excretory urography, cystoscopy and sigmoidoscopy. CT or MRI is not initially used as a part of evaluation. However, this clinical staging is more prone for errors and hence cross sectional imaging is needed in these patients for accurate staging. MRI accurately stages the carcinoma which is better than clinical staging. The FIGO classification does not include the nodal staging, which is an important prognostic factor in patient management. Brachytherapy and external beam radiotherapy are optimized with MR imaging. Also, MRI is the best modality of choice for imaging recurrence of tumor and in prediction of treatment response.

### 2. Objectives

The objectives of our study were to correlate MRI findings with FIGO staging of carcinoma cervix, to evaluate the efficacy of MRI in assessment of important prognostic factors in carcinoma cervix and to study the role of MRI in detecting the recurrence of carcinoma cervix in patients treated with radiotherapy.

**3. Materials and Methods**

This study was conducted as a hospital based observational study from June 2017 to June 2018. Around 70 patients who were histopathologically proven cases of carcinoma cervix and referred for MRI pelvis to the Department of Radio diagnosis, Coimbatore Medical College Hospital, Coimbatore were included in the study.

**3.1 Inclusion Criteria**

All carcinoma cervix patients who were referred to our department for MR imaging both newly diagnosed and those who were on post treatment follow up.

**3.2 Exclusion Criteria**

Patients with cardiac pacemakers, new implants, clips within the body and other contraindications of MR imaging like claustrophobia were excluded.

**3.3 Study methodology and MRI protocol**

After obtaining permission from the institutional medical research ethics committee and taking informed consent from the patients, they were subjected to MRI pelvis using a 1.5 – Tesla system. Body coils were used for imaging. The patients also underwent a complete clinical examination. The contrast gadolinium DTPA was given at a dose of 0.1 mmol / kg at a rate of 1 ml / second.

**Table 1:** MRI protocol

MRI Sequences	Non Contrast Scans		Fat Suppressed Scans	
	T1 W FSE	T2 W TSE	STIR	FS T1 W TSE (CONTRAST)
IMAGING PLANE	AXIAL AND SAGITTAL	AXIAL AND SAGITTAL	AXIAL	SAGITTAL, AXIAL CORONAL
TR/ TE (m sec)	633/ 11	6320/ 116	9060/14	500/ 11
FOV	1785*847	1785*847	1785*847	1785*847
SECTION THICKNESS	4 mm	4 mm	4 mm	5 mm
MATRIX	768*768	512*512	512*360	768*768

The following were assessed:

- Size of tumor
- Tumor enhancement
- Extension into the vagina and lower uterine body
- Parametrial / pelvic side wall involvement
- Urinary bladder / rectal wall invasion
- Presence of hydronephrosis and distant abdominal metastasis.
- Lymph node involvement
- Complications of radiation therapy

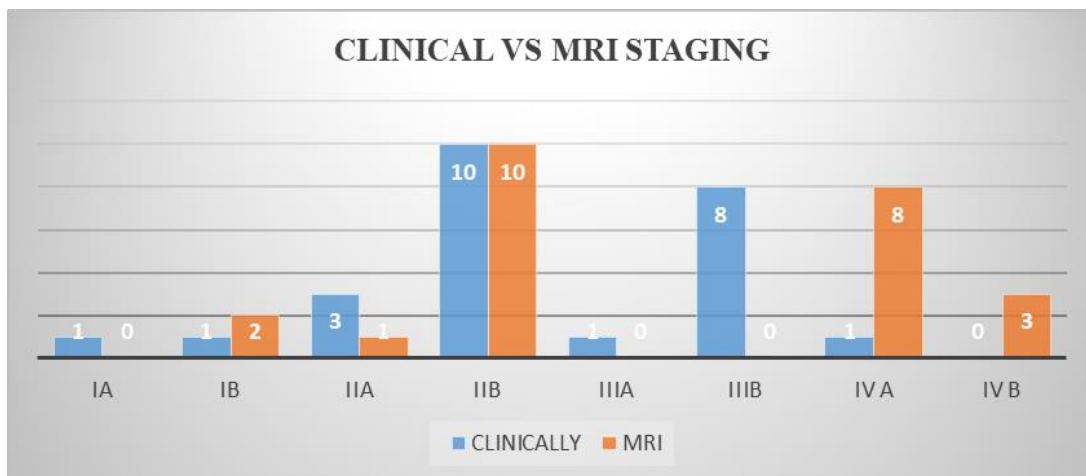
FIGO staging was incorporated into the MRI grading of the tumor and the correlation between the clinical and MRI FIGO staging was studied. In post RT patients, tumor recurrence and treatment response were studied.

**3.4 Statistical Analysis**

Chi-square test and student ‘t’ test was done. Diagnostic efficacy of MRI in terms of sensitivity, specificity, positive predictive value, negative predictive and accuracy was evaluated.

**4. Results and Discussion**

A total of 70 patients who were biopsy proven cases of carcinoma cervix were included in the study. FIGO stage was assigned both clinically and with MRI and the parameters were compared. Two categories of patients were considered for study- 26 newly diagnosed patients (37% of study population) and 44 treated cases (63% of study population). The most common presenting symptom was white discharge according to our study (seen in 57% of the study population) followed by lower abdominal pain (seen in 53% of patients). Among the new cases diagnosed, majority of them belonged to age more than 60. But, among the recurrent cases, the common age group was 41- 50 years. These patients must have been diagnosed with disease at an early age. Thus, when the life expectancy is more, the possibility of recurrence of tumour is also more. The most common histopathological type was squamous cell carcinoma in both newly diagnosed and recurrent cases. Majority of the patients belonged to post menopausal age group (57%). According to our study, the average time of disease free survival after therapy was about 2.5 years.



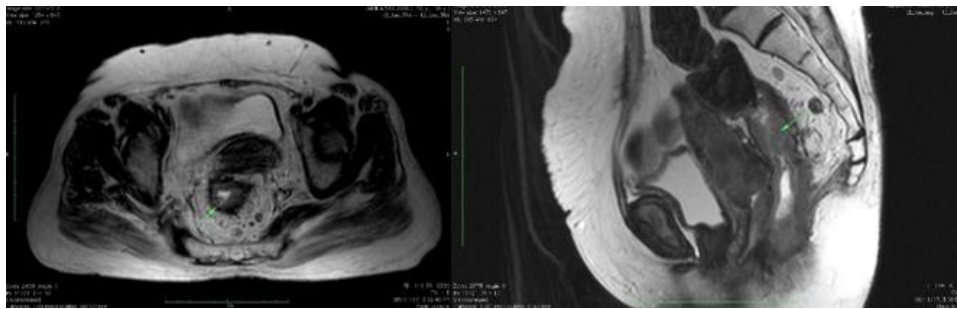
**Graph 1:** Comparison of correlation between clinical and MRI staging

MRI scored better in delineating the invasion of adjacent organs. In our study, significantly, 8 cases which were diagnosed clinically as stage III B were found to be stage IV A with MRI. Two cases of clinically staged IIA were actually found to have bladder invasion on MRI and hence

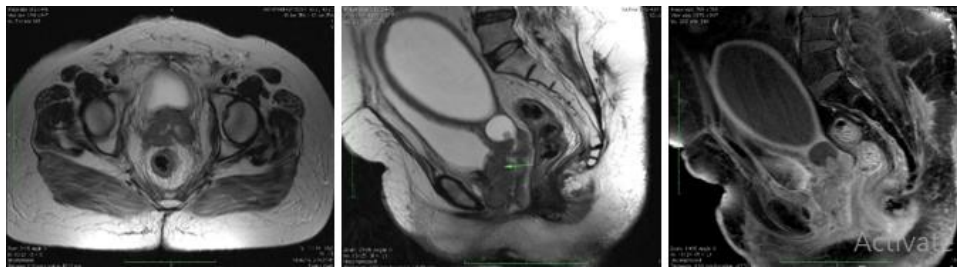
staged as IV A. Cystoscopy showed bladder invasion in 4 cases. However, on MRI, 9 cases were diagnosed. One patient had both carcinoma of rectum and cervix. Apart from this one more case was identified with rectal infiltration in sigmoidoscopy. However, MRI showed 3

cases with rectal infiltration. MRI evaluation prevented unnecessary surgical intervention in these patients [1]. Invasion of bladder and rectum can be ruled out with

sufficient confidence with MRI. This is in accordance with the previous study done by Kim *et al* [2].

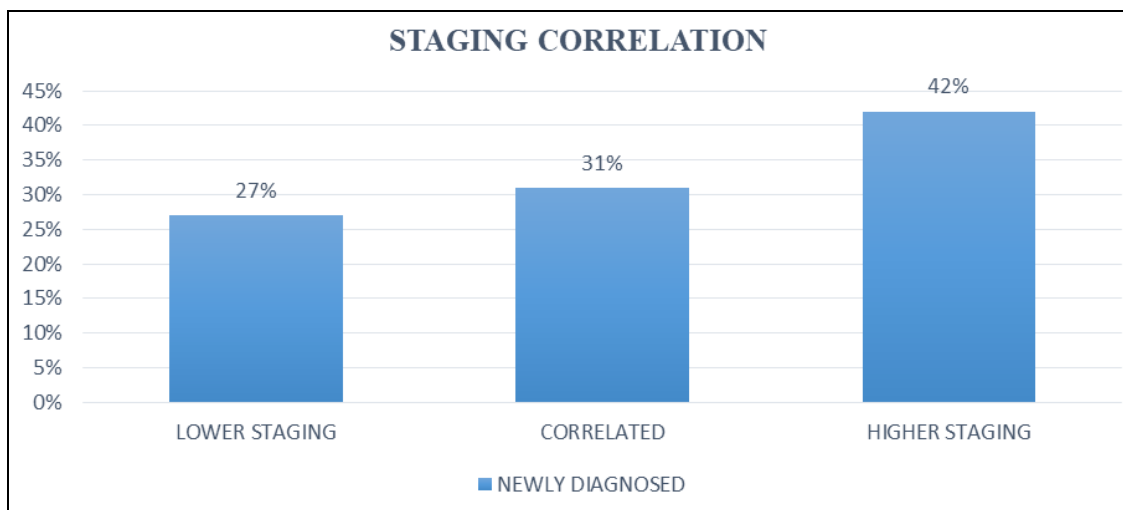


**Fig 1:** A 56 year old patient with previous history of carcinoma rectum and anal canal treated. Now, cervix shows a large mass with parametrial invasion and involvement of lower uterine body and upper vagina. Rectum also shows circumferential thickening with perirectal and presacral nodes.



**Fig 2:** A 70 year old female with growth in cervix extending to lower uterine body and upper vagina and also showed bladder infiltration.

**4.1 Newly diagnosed cases**



**Graph 2:** Comparison of correlation between clinical and MRI staging

**Table 2:** Comparison of correlation between clinical and MRI staging

Staging	Mri staging			
	Clinical staging	Lower staging	Correlated	Higher staging
IA	1	0	1	
IB	0	0	1	
IIA	1	0	2	
IIB	2	7	1	
III	3	0	6	
IV	0	1	0	
Total	7	8	11	

In our study, totally there were 26 biopsy proven new cases. Clinically mass was identified in 23 cases and was not

diagnosed for 3 cases. However, MRI showed the presence of mass in 25 cases. It was also noted that accurate staging was lacking in cases who underwent hysterectomy for early stage disease and for benign reasons. These patients would be benefitted with preoperative MRI. The accuracy, sensitivity, positive and negative predictive values of MRI in newly diagnosed cases are 88.19%, 88%, 92.59% and 95.65% respectively.

For all the newly diagnosed cases staged with FIGO system using clinical examination and MRI, correlation was the best for stage II B disease and higher staging was given with MRI to clinical stage III disease. MRI staging correlated with clinical staging in 31% of new cases and there was up staging with MRI for 42% of cases and down staging for

27% of cases. This was due to the reason that all the stage III disease patients diagnosed clinically had minimal bladder wall/ rectal wall invasion which was missed in scopy and the cases were misclassified. So MRI is advocated in all advanced cases for proper staging and prognostication.

**Table 3:** Positive MRI findings in different sequences

Positive mri findings	No of patients	Percentage
T2w	24	92%
Dwi	25	96%
Contrast	23	88%

MRI without contrast was reliable for assessing the parametrium and pelvic side wall invasion. T2 W images gave good information. This is in agreement with the study by Freeman SJ *et al.*, and Hawighorst *et al* [3, 4]. DWI- MRI was able to diagnose 96% of cases and T2 W and contrast images detected 92% cases. Among the 26 newly diagnosed cases (biopsy proven), T2 W, DWI and contrast enhanced imaging showed lesions in 24, 25 and 23 cases respectively. This is in concordance with the studies done by Hawighorst *et al.*, and Schiedler J *et al.*, who found that no value is added by this sequence [5]. This finding is also in concordance with the study by Lucas *et al.*, who reported a higher accuracy for the combination of T2 WI and DWI in the diagnosis of the lesion.

In our study, primary group of lymph nodes (parametrial, obturator, external and internal iliac nodes) was involved in

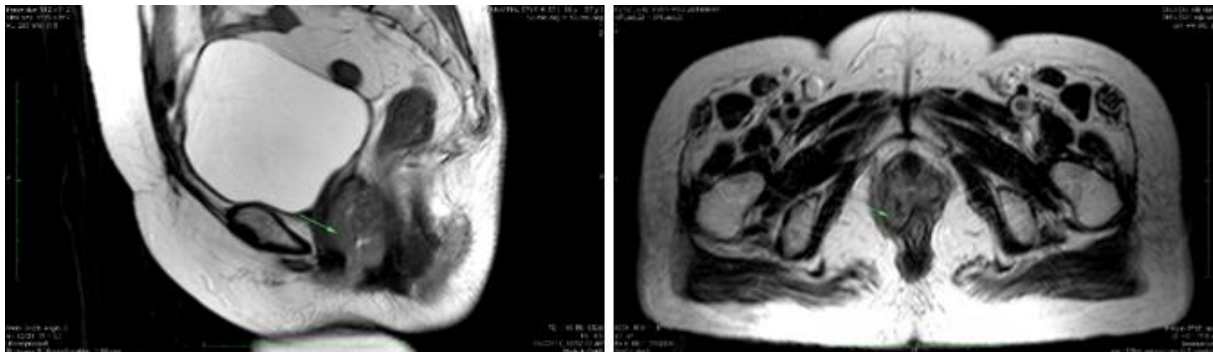
6 patients (23%) among the newly diagnosed. Secondary group of lymph nodes was involved in 3 patients. (11.5%). Involvement of secondary group of lymphnodes (common iliac, inguinal and paraaortic nodes) correspond to stage IV B [6].

**4.2 Post treatment cases**

**Table 4:** Correlation between MRI and clinical findings

Clinically suspected mass	Mri findings	
	Present	Absent
Present	16	14
Absent	2	6
Not assessed	4	2

From our study involving post treatment cases, there was no added value of routine contrast imaging for all post radiotherapy cases. It has value in case of discrepancies between findings in T2 W imaging and DWI where it serves as a problem solving tool. In our study, altogether 22 patients showed lesion on MRI. The number of patients showing lesions on T2 W, DWI, and contrast studies were 24, 22 and 18 respectively. A combination of T2 W imaging and DWI was able to diagnose all the 22 cases and also excluded the 2 false positive cases in T2 W imaging. This finding is in concordance with the study by Lucas *et al.*, who reported a higher accuracy for the combination of T2 WI and DWI in the diagnosis of the lesion.



**Fig 3:** A 57 year old patient with previous history of hysterectomy. MRI showed vault recurrence with infiltration of vulva, urethra and left ischioanal fossa.

In our study, MRI helped to exclude the patients with no recurrence of tumour or no residual mass in post treatment phase so that over treatment of these cases with radiotherapy could be avoided. It also aided in the diagnosis of recurrence in 6 cases which were clinically undiagnosed so that appropriate treatment could be instituted in these cases. One

of the patients had pure nodal recurrence with no pelvic mass and MRI helped in the diagnosis. The accuracy, sensitivity, specificity, positive and negative predictive values of clinical examination in recurrent cases are 57.89%, 88.89%, 30%, 53.33% and 75% respectively.



**Fig 4:** A 65 year old female, a known case of carcinoma cervix post radiotherapy now presented with white discharge. Clinically recurrence is suspected. MRI showed bulky cervix with altered signal. No area of diffusion restriction was noted. Contrast showed no abnormal enhancement. A case of post radiation fibrosis.



**Table 5:** Comparison between clinical assessment and MRI

Parameters	New (of mri)	Recurrent (of clinical examination compared with mri)
Sensitivity	88%	88.89%
Positive predictive value	92.59%	53.33%
Negative predictive value	95.65%	75%
Accuracy	88.19%	57.89%

In the post treatment cases, primary group of nodes was involved in 5 patients and secondary group in 4 patients. This is lower than that reported by Drescher *et al* in his study. This may be because his study included more number of patients with histology of adenocarcinoma [7].

**4.3 Prognostic indicators**

The most important prognostic indicators are size of the tumour, uterine body involvement by the tumour and nodal

metastasis.

In our study, the uterine body involvement could be positively correlated with lymph nodal metastasis with a significant “p value” of 0.025. Among the 28 cases with uterine body involvement, 7 patients showed primary lymph node metastasis and 3 patients showed secondary lymph nodal metastasis. Thus, uterine body involvement could be directly correlated with advanced stage of the disease and higher prevalence of distant metastasis [8].

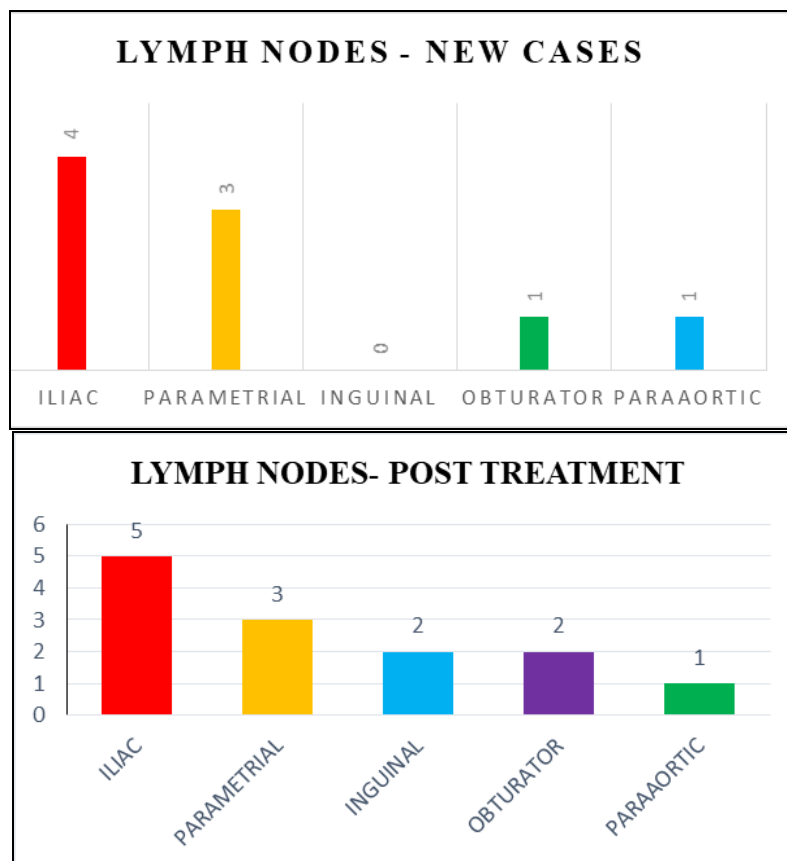
**Table 6 & 7:** Correlation of uterine body involvement with MRI staging and lymph node involvement

Uterine body involvement		
Mri staging	No of patients	Percentage
Ib	2	7%
Iib	9	32%
Iiia	1	4%
Iva	13	46%
Ivb	3	11%

Uterine body involvement		
Lymph node	New	Recurrent
Primary	5	2
Secondary	1	2
Mann whitney test		
P value- 0.025		
Significant		

Mean size of the tumour is another important prognostic factor as this could be correlated with the stage of the disease and nodal involvement. The mean size of the tumour correlated

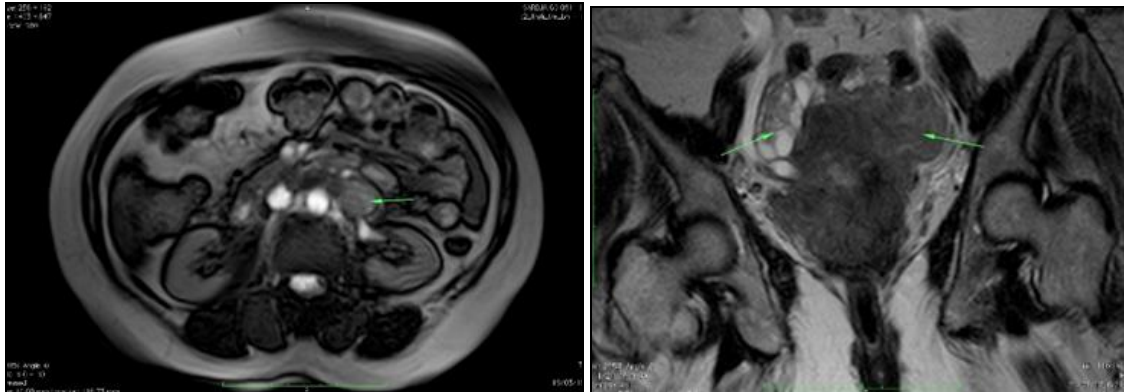
well with tumour staging in stages greater than IIA. There was nodal involvement if the mean size of the tumor crossed 5.67 cm.



**Graph 3 & 4:** Involvement of lymph nodes

**Table 8:** Post radiation complications.

Post radiation complication	No of cases	Percentage
Bone marrow changes	8	20.5%
Cystitis	8	20.5%
Proctitis	8	20.5%
Pelvic lipomatosis	2	5%
Free fluid	2	5%
Vesico vaginal fistula	1	2.5%
Ureteric stricture	1	2.5%
Pyosalpinx	1	2.5%

**Fig 5:** Paraaortic nodal involvement and extension of the growth to both ovaries showing solid cystic areas.

### Conclusion

To conclude, when MRI was compared with clinical FIGO staging of carcinoma cervix, lesion is easily identified by MRI. MRI staging correlates well with clinical staging in II B. Hence, it greatly helps in deciding treatment. A combination of T2 and DWI is the optimum technique in both new and recurrent cases. Invasion of parametrium, pelvic side wall and adjacent organs are depicted clearly in MRI. Nodal status is also assessed using these sequences. Size of mass lesion, uterine body involvement and nodal metastasis are important prognostic factors that could be correlated with the stage of disease and these are assessed better using MRI. Complications of radio therapy are also better evaluated using MRI. MRI, therefore can be used as a single best investigation in the staging obviating the need for multiple invasive procedures.

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From our study, post radiation complications were more common to develop after 2-3 years of radiotherapy which also corresponded with the average time of recurrence. Since most of the patients are referred during this time to look for recurrence of tumour, more complications are also diagnosed during this time. The most common post radiotherapy changes were fatty replacement of bone marrow followed by cystitis and proctitis<sup>[9,10]</sup>.

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