

Technique for Performing Magnetic Resonance Imaging (MRI) of the Cervical Spine at the Mali Hospital

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Abstract

Original Research Article

Introduction: Magnetic Resonance Imaging is one of the non-invasive or irradiating medical imaging techniques. MRI explores with precision the organs and soft tissues, in the different planes of space (2 to 3 Dimensions). In patients with neurological signs suggestive of cervical spinal cord compression, MRI is the reference examination, even normal CT and X-rays. **Objective:** To highlight the technique of performing MRI of the cervical spine in patients admitted to the Medical Imaging department of the Mali hospital. **Method:** This was a prospective and descriptive study that took place from October to December 2018. The MRI device used is low field (0.35T) and open. This study included 23 patients who had undergone MRI of the cervical spine. **Results:** These different methodologies enabled us to obtain the results of 23 patients. The male sex was more represented with 60.87% against the female sex or 39.13%. Among the most common reasons, paralysis is 52.17% of our examinations carried out. The average age was 47 years with extremes ranging from 16 to 75 years. The most represented age group in our series was 46 to 55 years or 30.43%. These results confirm the relationship between cervical pathologies and professional activities, men being the most active in Mali. MRI examinations of the cervical spine were 23, out of 165, or 07%. **Conclusion:** MRI has revolutionized the imaging of the cervical spine as this technique proves to be complete and efficient for the study of all the anatomical structures of the spine, of which it allows the most precise diagnostic assessment. Despite the low capacity of the installation and the lack of people trained in its implementation, the technique meets the standards of implementation and produces quality diagnoses with the assistance of radiologists.

Keywords: MRI, cervical spine.

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INTRODUCTION

Medical imaging is a set of techniques consisting in imaging different anatomical regions of the body or different organs of the body for medical purposes (Adjenou K *et al.*, 2016).

There are several types of techniques in medical imaging which are more or less suitable depending on the areas to be studied. A distinction is made in particular between radiography, ultrasound, scanner, nuclear medicine and magnetic resonance imaging (MRI). MRI and CT provide cross-sectional images and make it possible to represent organs in 2 to 3D (Adjenou K *et al.*, 2016).

Lesions of the cervical spine represent 55% of spine pathologies in adults. In France they represent

11.11% and in MOROCCO, it was reported by BRECK with a frequency of 83.3% of these pathologies (Auclair Y *et al.*, 2016).

In Mali, the first high-field MRI installation (1.5 Tesla and closed type) at the Center Hospitalier Universitaire (CHU) Point G and that of the Mali hospital, low field (0.35 Tesla, Neusof brand and open type) in 2015.

MRI provides information on lesions that are not visible by standard X-rays, ultrasound or CT (Adjenou K *et al.*, 2016).

It studies with great precision many organs such as the brain, the vertebral column, the spinal cord, the joints and the soft tissues. MRI is neither invasive nor irradiating. MRI represents an unequalled diagnostic

tool in orthopedic, rheumatological and oncological pathology thanks to its excellent tissue contrast (Shahabpour M *et al.*, 2018).

In Mali as of today, no study has yet been made on the technique for performing MRI of the cervical spine. This is why we initiated this study to highlight the technique of performing MRI of the cervical spine at the hospital in Mali in order to make proposals for improvement in relation to international standards.

MATERIALS AND METHODS

Ethical Aspects

The study was conducted in accordance with the ethical standards set out in the Declaration of Helsinki (1983). Inclusion in the study was carried out according to the rules of the legislation in force at the hospital in Mali and strict respect for the confidentiality of the identity of the patients and their results.

Type of Study and Participants

This was a prospective and descriptive study that took place in the medical imaging department of the hospital in Mali. This study had included 23 patients in said hospital from October to December 2018. Eligible patients were selected according to the inclusion criteria as follows: all patients whose cervical spine MRI examinations could be performed in the medical imaging department during the study period.

CONTRAINDICATIONS TO THE MRI INSTALLATION:

They are those related to the magnetic field of the MRI.

⇒ **Absolute contraindications related to magnetisms**

- Pacemaker/implantable cardiac defibrillator,
- Intraocular or intracranial metallic foreign body,
- Metal heart valve (except some newer models),
- Old intracranial vascular clips (ferromagnetic),
- Old ferromagnetic implants (stents, coils, filters, etc.).
- In these cases, it will be requested to do a scanner of the cervical spine multi-planar reconstructions.

⇒ **Relative contraindications:**

To patients

- Anxiety, claustrophobia.
- Uncontrollable agitation, severe respiratory problems.
- Ordinary non-removable dental material (the removable has been removed).
- Intracranial electrodes (in case of Parkinson's disease for example).
- Old heart valves.
- Cochlear implants.

To the Product Gadolinium

- The injection of contrast product should be avoided during the first trimester of pregnancy.
- Severe kidney failure.
- Gadolinium allergy.
- Feeding with milk.
- Iodized product reviews wait 48 hours.

Restrictions

The region studied must be immobile, which requires general anesthesia but very rare in the case of cervical spine trauma.

A. EQUIPMENT:

1. A Balance: for the appreciation of the weight. The weight is a criterion for carrying out the examination, beyond 100kg our MRI installation cannot carry out the examination.
2. MRI device: 0.35T super open (low field) open MRI, brand NEUSOFT.
3. A volume antenna dedicated to the spine.

B. DATA LOGGING AND ANALYSIS:

- The data was collected from a survey form and direct observation of the performance of the examinations.
- Data were entered in Office Word 2013 and analyzed by SPSS version 26.

C. CERVICAL MRI PROCEDURE AT THE HOSPITAL IN MALI:

The Mali hospital has an open MRI installation, branded "Super open- Neusoft" with a power of 0.35 Tesla.

A medium volume coil was used for MRI examinations of the cervical spine.

- MRI was performed by appointment (RDV), but emergencies are taken care of directly.
- Appointments were made either face-to-face or over the phone. It was given after having eliminated the contraindications of the examination on presentation of an examination request form (justification);
- On the day of the examination, the patient or accompanying person presents himself with the request form to the medical imaging secretariat and sometimes with the contrast products that were prescribed when making the appointment;
- The autonomous patient was received in the room, to prepare by asking him to get rid of everything that is prohibited in the MRI room and then for the weighing.
- The bedridden patient was admitted directly into the room, after having removed all the objects which are prohibited.
- Explain to the patient: the entire course of the examination, interest in immobility,

examination is non-irradiating and painless, noise from the MRI device during the sequences and the average duration of the examination in order to have his cooperation.

- Ask the patient to empty the bladder before the examination,
- Admission of the patient to the examination table with qualified personnel, especially in the event of trauma. Then, it was installed comfortably lying on the back most generally; the arms along the body, the knees are on the kneepad to have stability and respect for the lumbar lordosis and the cervical spine in the cervical volume antenna. Because the exam had an average duration of 20 minutes.
- The table and the patient are positioned under the magnetic field and the patient was informed that during the acquisition of the images, the machine emits a rather intense and rhythmic noise which can be unpleasantly felt. It is important to maintain absolute immobility and to breathe regularly during the examination so as not to distort the images, the eyes could be closed or open.
- Once again, the patient was assured of the permanent supervision of the technical staff despite the apparent isolation. Also thanks to a microphone and loudspeakers, exchanges are possible with the staff if necessary.
- Finally, the antenna is connected to the rest of the device.
- At the console of the device, the surname, first names, sex and weight and identification number were entered;
- The following standard sequences were performed:
 - Scout- view in the 3 planes of 23 seconds with slice thicknesses ranging from 10 to 12mm.
- **Sequences without contrast product injection:**
 - T1 SE, duration 4 minutes;
 - T2 SE, duration 4 to 5 minutes;
- The following additional sequences are carried out if necessary:
 - T2 STIR sagittal: Time between 4 and 4.5 minutes.
 - T2 * axial on the lesions: Time 5.39 minutes.
- **If there is injection of the contrast product:**
 - The injection of contrast product was rarely performed. It consisted of manually injecting 10cc of gadolinium chelate, which was

followed by 20cc of saline. It was usually made in the tumoral or infectious lesions;

Sequences:

- T1 gadolinium sequences in the three planes (sagittal, coronal, and axial) were performed after IV contrast.
- In total, the average duration of the cervical MRI examination was between 18 and 37 minutes (installation and removal of the patient thus included).
- Except in cases where the patients were accompanied by the nursing staff, the results were available within 48 to 72 hours after the examination.

At the hospital in Mali, certain criteria are evaluated to assess the success of the examination, these include:

- The symmetry of images;
- The absence of motion blur (image must be sharp and visible);
- The absence of artifact,
- Acquisitions of all standard sequences are necessary for basic diagnosis.

RESULTS

At the end of our study, we collected 23 patients, having benefited from an MRI of the cervical spine, out of the 165 MRI examinations, ie a frequency of 07%.

Sex:

Table I: Distribution of patients according to sex

Sex	Effective	%
Male	14	60.87%
Feminine	9	39.13%
Total	23	100.00%

The male sex represented 60.87% with a sex ratio of 1.55 in favor of men.

Age Range:

Table II: Distribution of patients according to age group

age range	Effective	%
16-25	2	8.70%
26-35	4	17.39%
36-45	5	21.74%
46-55	7	30.43%
55 and over	5	21.74%
Total	23	100.00%

The average age was 47 years with extremes ranging from 16 to 55 years and over. The 46-55 age group was the most represented with 30.43%.

The Weight:

Table III: Distribution of patients according to weight in kg

Weight (Kg)	Effective	%
45-55	3	13.04%
56-66	4	17.39%
67-77	6	26.09%
78-87	7	30.43%
88-98	3	13.04%
Total	23	100.00%

The majority of our patients had a weight between 78-87kg with 30.43%.

Reason for Review:

Table IV: Distribution of examinations according to clinical information

Grounds	Effective	%
Paralyzes	12	52.17%
neuralgia	6	26.09%
Discopathies	2	8.70%
neck pain	2	8.70%
Paresthesia	1	4.35%
Total	23	100.00%

The dominant reason was paralysis, the 52.17%, followed by cervico-brachial neuralgia with 26.09%.

The duration of the examinations carried out:

Table V: Breakdown of examinations according to examination duration

Duration of sequences performed	Effective	%
13-20	15	65.22%
21-25	5	21.74%
26-32	3	13.04%
Total	23	100.00%

65.22% of our exams were completed between 13-20 minutes.

ICONOGRAPHY: IMAGES AT THE HOSPITAL IN MALI



Figure 1: Sagittal section; T1 weighting, normal image



Figure 2: Sagittal section; T2 weighting, normal image



Figure 3: Sagittal section STIR T2, pathological image



Figure 5: Sagittal section; T2 weighting, pathological image



Figure 4: Sagittal section STIR 2, pathological image



Figure 6: Coronal section, T1 gadolinium, pathological image

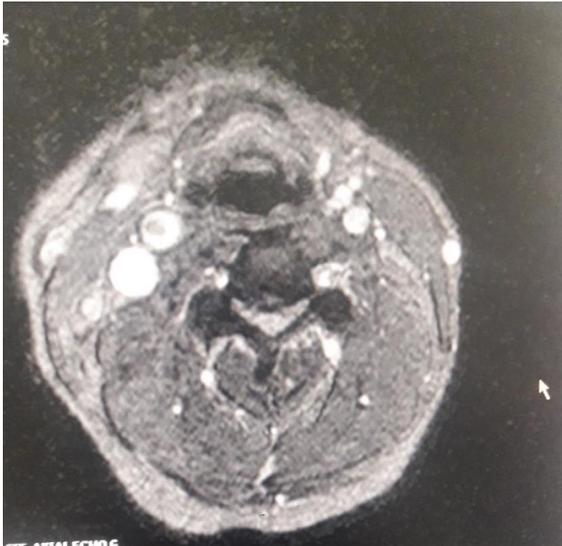


Figure 7: Axial slice, T2* weightings on C2-C3 disc, pathological image

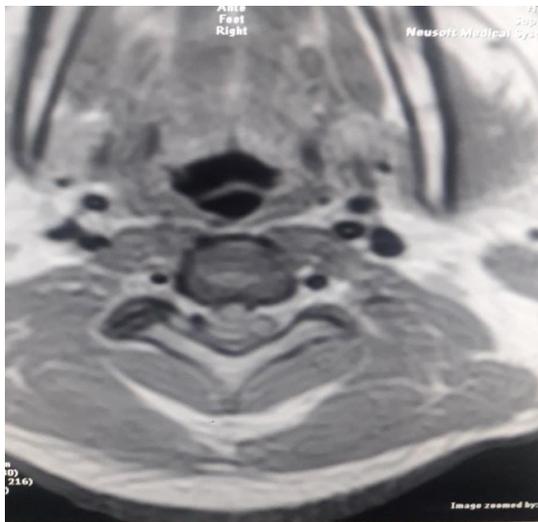


Figure 8: Axial slice, T1 gadolinium on C1-C2 disc, pathological image

DISCUSSION

The objective of our work was to highlight the technique of performing MRI of the cervical spine at the hospital in Mali and to make proposals for improvement in relation to international standards for better management patients.

We used a scale and an open MRI installation of 0.35 Tesla, 23 patients were selected after application of the criteria, including weight, because the installation can only perform an MRI examination in patients with a weight included between 50 and 100 kg.

The evaluation of the technique through human resources focused on the only person handling the device, she received specific training on MRI in Morocco after her master's degree in medical imaging and extensive exercise experience.

Socio-Epidemiological Data

- ❖ **Age:** The average age of our patients was 47 years old with extremes of 16 and 75 years old. The most represented age group in our series was that of 46 to 55 years or 30.43%. These results were close to that of Hajar, C. *et al.*, 2015 who had obtained an average age of 36.3 years with age limits of 15 and 53 years and a most represented age group 40 to 50 years with 32.3%. This is explained by the fact that our majority age group represents the age of full professional activity in Mali.
- ❖ **Gender:** In our study, the male gender accounted for 60.87% of cases. This male predominance was also obtained by Doumbia, D. 2018 with 55% and Doumbia, S. 2016 which had obtained 75% with a sex ratio of 3 in favor of the male sex. But our results are contrary to those of Hajar, C. 2015 who had obtained 69.4% women. These results confirm the relationship between cervical pathology and professional activities, men being the most active in Mali.
- ❖ **Clinically:** The clinical signs indicated on the request forms as reasons for carrying out the MRI of the cervical spine were, among others: Paralysis (52.17%), cervico-brachial neuralgia (26.09%), discopathy (8, 70%), neck pain (8.70%) and paresthesia (4.35%). These are similar to the results of Auclair Y *et al.*, 2015 who found 82% tetraparalytic syndrome type motor signs, 29% paraplegia, 22.6% hemiplegia and 19.4% monoplegia. Our results are different from that of DOUMBIA S, 2016 who obtained 29% of cervico-brachial neuralgia followed by tetra paresis 18.8%.
- ❖ **Cervical Spine MRI Exam Times:** During our study, 65.22% of cervical MRIs were performed between 13 and 20 minutes. This result was comparable to those of Philippe, R. *et al.*, 2011 who had obtained a time of between 10 -15 minutes with a low-field 0.3T MRI installation. This was due to the low power of our machine (0.35T). Time for installation and uninstallation of the patient was approximately 10 minutes.

CONCLUSION

The realization of the standard radiography remains the basis of all imaging of the cervical spine.

MRI has revolutionized the imaging of the cervical spine, as this technique has proven to be complete and efficient for the study of all the anatomical structures of the spine, for which it allows the most precise diagnostic assessment.

Despite the low capacity of the MRI facility and the lack of people trained to perform MRI examinations, the technique meets performance standards and produces quality diagnoses with the assistance of radiologists.

With the installation of a high-field device and the training of other technicians in the handling of the installations, MRI examinations of the cervical spine will be extended to other categories of patients, an expanded field of application for the production of diagnostics and followed by even better diseases.

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