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What does the orthopaedic surgeon want in the radiology report?

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ABSTRACT

Complementary imaging is crucial in the diagnosis and management of the spectrum of Musculoskeletal (MSK) pathologies. Like in all medical specialities, its role in trauma and orthopaedic conditions has evolved. A radiology report following an imaging study should provide an accurate, timely interpretation of images and be presented in a format that allows formal analysis or clarification of a patient's diagnostic dilemma. It is essential that it is descriptive enough to allow clinico-pathological correlation to a patient's condition. A high-quality report follows clinical governance processes, provides clinical feedback, and when appropriate, incorporates advice regarding differential diagnosis or further investigation/management that can be undertaken, permitting the attending clinician to formulate a suitable treatment plan for their patient.

In this narrative we explore common radiological investigations and reporting information in trauma and orthopaedic conditions, which would be useful to the attending surgeon.

1. Introduction

Radiology is a distinct medical speciality and has become a crucial diagnostic tool for various diseases. It has evolved to play an important role in the monitoring and treatment of patients with the advent of interventional radiology.[1–3]

MSK radiology involves a spectrum of technologies, ranging from plain radiography to newer techniques, such as Computerised Tomography (CT), Magnetic Resonance Imaging (MRI), and Nuclear and Molecular imaging. Radiological imaging is an essential modality for investigating patients with musculoskeletal conditions, including trauma. It not only helps us to corroborate the clinical examination findings, but also helps narrow down and confirm the differential diagnosis. Although these investigations are complementary, they can occasionally be crucial in the clinical management of a patient. They aid in the surgical planning of procedures and decision-making process e.g. deciding what technique of intervention will be utilised. i.e. arthroscopic vs open surgery, replacement vs repair/reconstruction of structures.

Interpretation of radiological imaging is a highly developed skill, and the findings conveyed in a digital or written format form the basis of a Radiology report. Consequently, the Radiology report, by a qualified Radiologist, forms a cornerstone in guiding appropriate patient management and treatment on the requested investigations.[4–6]

The foremost aim of a Radiology report is to represent the analysis of a particular radiological imaging study, collaborating it with the patient's medical history and clinical features.[7] The report represents a formal documentation of the results for the referring clinician. Despite this era being one of digital technological advancements and Picture Archiving and Communication Systems (PACs), written Radiology reports remain the primary method of communication between the referring clinician and the radiologist in several countries.[8–10]

Radiology reports should highlight the clinical importance of any imaging findings in an informative way, answering the clinical query to help direct patient care.[11] This may include confirmation of

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a clinical diagnosis, clarification of a clinical-radiological finding, or monitoring the progress of clinical conditions such as fracture healing. It is essential that the orthopaedic surgeon ask the right question which they need answering.

Not only do Radiology reports form a vital communication tool regarding the management of a patient's condition, but they are also important medico-legal documents which provide significant evidence in malpractice claims.[12,13] Various national and international radiology associations have published guidelines to standardise radiology imaging reports in a format that will provide appropriate care to the patient.[14,15]

We highlight the essential elements of a typical MSK Radiology report, which will support the referring orthopaedic surgeon in the clinical management of their patient.

2. Elements of a typical radiology report – an orthopaedic surgeon's perspective

A clear and a concise radiology report, with respect to MSK pathologies, is one which follows a structured format, is consistent in nature, and provides clarification with regards to confirmation of a diagnosis or highlights recommendations towards on further diagnostic tests.

Table 1 lists some guidelines that can form the basis of a typical radiology report from an Orthopaedic surgeon's perspective. (Table 1).

1) **Date and Time of the Imaging study**: This is mandatory for every radiology report and for medico-legal purposes. Along with the date and time of the investigation, it must be indicated whether it was an urgent or a routine investigation. For example, MRI spine undertaken for Cauda Equina signifies an urgent imaging request and impacts clinical management of the patient.
2) **Title and Type of radiological examination:** The type of imaging, the position of the patient, the use of contrast, and whether dynamic or static, should be displayed in the title of the report, as well as whether the investigation is a plain radiography/CT/MRI/or another form of radiological imaging.
3) **Interpreting Radiologist**: The name and grade of the reporting Radiologist should be clearly indicated so that the individual is contactable for further clarification of the report if required. If the individual is not available, systems should be in place to ensure that an equally experienced and qualified Radiologist is available for discussion.
4) **Clinical query:** The referrer should furnish an appropriate and relevant history with a clinical query when requesting the investigation. This will enable the Radiologist to scrutinize and summarise the patient's finding and thereby provide an effective imaging diagnosis. The radiologist could suggest the best modality to answer this clinical query.
5) **Structured vs Unstructured report**: There is a debate in literature whether a report should be structured or unstructured (free text, narrative reporting). However, despite its limitations, structured reporting is substantially increasing. A structured report has a template, with a logical pattern of reporting and predictable subheadings using standard terminology. It is believed a structured template is a useful tool to assist clinical decision making.[16]
6) **Technical information:** A comprehensive technical aspect of the examination technique is useful when mentioned in the report emphasizing the details undertaken to clarify a particular diagnosis or rule out a pathology for example, 2 mm axial images in CT or Fat-suppressed T2-weighted (FS-T2) images or short tau inversion recovery (STIR) imaging.[17]
7) **Contents/Findings/Impression**: Findings indicating whether the report is normal or abnormal, answering the clinical query and advising on whether further investigations or follow-up imaging are advisable. A description of the anatomical site and correlation with possible pathological conditions would be useful. The Radiologist should also compare the current imaging to previous similar imaging - if any - and mention any changes in the report.
8) **Follow-up suggestions**: Radiologist recommendation on follow up testing/imaging studies (e.g. a biopsy or additional diagnostic imaging) will guide the referring orthopaedic surgeon in the future treatment or monitoring of the patient.

Table 1
Elements of a typical Radiology report for Orthopaedic Surgeons.

	Attribute	Characteristic with examples
1	Date of Exam	Date, time of the imaging (e.g. MRI spine for suspected Cauda Equina signifies an urgent imaging)
2	Name or Type of Exam	• Plain radiographs/CT/MRI/Nuclear medicine imaging
	Type of radiographic view	• With or without contrast • Dynamic or Static? • Position: standing or sitting ((e.g.) Standing radiographs in knee osteoarthritis) • Mobile radiographs: Flexion and extension view in spondylolisthesis • Serendipity view (sternoclavicular joint) • Judet views (acetabular fracture) • Mortice view (ankle injuries) • Sunset/skyline view patello femoral dysplasia • Von Rosen view (Developmental Dysplasia Hip)
3	Interpreting Radiologist	The name of the reporting Radiologist who read the diagnostic imaging exam and available for further clarification of the report if required
4	Clinical Query	Background interpretation of clinical history provided by the requesting surgeon and surgeon's query.
5	Type of report	• A structured report would allow clear understanding of the flow of the report
5	Technique	Technical details of the exam (such as “2-view x-ray” or “2 mm axial images for CT” or FS-STIR for MRI), and if contrast was used.
6	Comparison	Describe the present study and use past tense to describe comparison with previous studies/images.
7	Contents/Findings /Impression	• Clinically relevant findings • Radiologist impression of the imaging study. Was it abnormal or a normal finding?
8	Follow-up Suggestions	Radiologist recommendation on follow up testing/imaging studies (e.g. a biopsy or additional diagnostic imaging)
9	Subspeciality reporting	• Oncology reporting for staging of disease and MDT discussion • Post-operative implant surgery e.g. Fracture healing/infection clarification
10	Conclusion	An effective conclusion to summarise key findings

Abbreviations: CT= Computerised Tomography; MRI = Magnetic Resonance Imaging; FS-STIR= Fat Suppressed - Short-TI Inversion Recovery; MDT = Multidisciplinary Team meeting.

Table 2
Common radiological Investigations and examples of reporting information for surgeons for in orthopaedic Trauma.

Attribute	Plain Radiographs (X-rays)	Ultrasound (USS)	CT	MRI
Views	• Images in 2 planes and joint above and below the injured bone	Typically for Tendon Injuries e.g. Rotator cuff, Tendo Achilles Need quantification and qualification of injury (size, dimension, shape, retraction)	High resolution axial, coronal and sagittal (thick cut 2.5 mm views when not adequate) e.g. patient after a fall, painful hip and fracture confirmation when Plain x-rays not clear.	Same as per USS. Required sagittal coronal and axial images Similar would apply for knees, elbows, etc.
Occult fracture	• Report can highlight this to bring it surgeon's attention especially if they are obscure E.g. Epiphyseal injuries • Presence of occult fracture, especially hairline fractures with intra articular extension	Rotator cuff injuries involving partial avulsion of Greater tuberosity localization of fracture haematoma	Scaphoid fractures and other such sites Especially in areas covered with bones such as chest wall and pelvic injuries	E.g. • SCIWORA • For displaced or occult fractures neck of femur • Stress fractures
Skipped injuries	• Especially in Trauma Spine reporting following Polytrauma or Motor vehicle accident		Fractures of the endplates, and tear drop fractures Avulsion fractures of cervical spinous process	SCIWORA
Fracture Healing	• Evidence of callous formation	• Associated soft tissue injury	• Grading of fracture healing, Delayed and Non-union, • CT-Classification of Non-union	• Check vascularity at Non-union site especially in early non-union Scaphoid and femoral neck
Other		Assess of fluid collection E.g. serum, blood or pus		

Abbreviations: CT=Computerised Tomography; MRI = Magnetic Resonance Imaging; SCIWORA= Spinal Cord Injury Without Radiographic Abnormality.

Table 3
Common examples of Elective Orthopaedic radiological reporting information for surgeons.

Orthopaedic Pathology	Plain Radiographs (X-rays)	Ultrasound (USS)	CT	MRI
Degenerative joint disease e.g., Glenohumeral arthritis	Static joint subluxation. Humeral head centred or decentred on the glenoid. Reduction in the acromiohumeral distance?	Condition of the rotator cuff i.e., tears or attenuation.	-Measurement of glenoid version and inclination. –Condition of the glenoid vault and degree of glenoid bone loss.	In addition to the status of rotator cuff tendon, information on muscle bulk and fatty infiltration.
Chronic/ Recurrent Instability e.g., patellofemoral instability.	Patella height and tilt. Presence of trochlear dysplasia. loose bodies.	Joint effusion. Extensor mechanism.	-Loose bodies. -Tibial Tuberosity − Trochlear Groove (TT-TG) distance.	-Osteochondral lesions. -Medial patellofemoral Ligament (MPFL) tear.
Tendinopathy e.g., recalcitrant tennis elbow	Arthritis in the radio-capitellar joint. Presence of calcification or bony spurs over the lateral epicondyle.	Changes of tendinopathy and any tear in the common extensor origin.	Radio-capitellar joint arthritis.	Changes of tendon degeneration. Tear in the common extensor origin, condition of Lateral Ulnar Collateral ligament i.e., tears or attenuation. Presence of radio-capitellar plica.

Abbreviations: CT=Computerised Tomography; MRI = Magnetic Resonance Imaging.

9) **Subspeciality reporting:** These can be specifically important in subspeciality orthopaedic conditions. For example, Shoulder imaging -In addition to the status of rotator cuff tendon, information on muscle bulk and fatty infiltration is useful (Goutallier Classification of Fatty Infiltration of the Rotator Cuff Musculature).[18] (Table 2–4).
10) Conclusion**:** After the Radiologist has given a descriptive report, it would be helpful for them to provide a summary of key findings and their interpretation relevant with the clinical query.

3. Subspeciality reporting and orthopaedic pathologies - special features in the orthopaedic radiology report

3.1. Pathology reporting

MSK infections can pose a diagnostic challenge, and therefore, advanced imaging modalities play a pivotal role in the confirmation and localization of suspected infection. For deep seated purulent infections, a comprehensive report must provide information about the size, exact anatomical location (surgical compartment), extent, and, critically, the relation to neurovascular structures, all of which is invaluable for pre-operative surgical planning. If it is felt that the report needs to be conveyed instantly, it should be verbally communicated to the referring clinician or flagged up for urgent attention.

In patients presenting with painful arthroplasty, the most common differential includes aseptic prosthetic loosening and periprosthetic joint infection. An array of diagnostic tests is often required to differentiate between the aforementioned. The use of a metal artefact reduction sequence (MARS) is essential to assess the incorporation of an implant, abnormalities in the bones and soft tissue changes around the hip. Comments on any associated soft tissue masses or fluid collections around metal implants would be particularly useful to determine the cause of failure of the implant, predict the need for future revision and aid the choice of revision prostheses.[19–21] In cases with diagnostic uncertainty on

Table 4
Common representative information and examples on postoperative imaging report that would be useful for orthopaedic surgeons.

	Plain Radiographs (X-rays)	Ultrasound (USS)	CT	MRI
Views	• Is the skeletal Imaging undertaken adequate?	Dynamic evaluation	High resolution axial, coronal, Sagittal, 2 mm slices	e.g. check for early AVN in hip fractures
Fracture Union	• Confirm if a particular fracture has united or not radiologically • Sclerosis of bone ends and obliteration of canal	Use to detect soft cartilaginous callus early in course of bone healing Bone union	-Evidence of union and degree of union e.g. Delayed union -Pointers which images show this.	To check for early union to enable removal of metal work if required
Infection	• Metal work associated infection- e.g. lysis around implants suggestive of Infection	• To check for soft tissue post-operative collection. e.g. abscess/seroma • Morel-Lavallée lesion - closed degloving soft tissue injury	Bone involvement and severity	Soft tissue and bone involvement, suggestion whether this is oedema or infection. Structures involved; planes/ compartments breached
Metal work problems	• Confirm osseous union or suggest additional investigations to clarify in operated patients with metal implants in situ	Check for tendon injuries or early attrition, e.g. long dorsal screw in the distal radius following volar plate fixation	Metal supressed images essential. Need same info as x- ray section	-Pseudo aneurysms following Metal on Metal hip replacements - MARS imaging

Abbreviations: CT= Computerised Tomography; MRI = Magnetic Resonance Imaging; AVN = Avascular Necrosis; SCIWORA= Spinal Cord Injury Without Radiographic Abnormality; MARS = metal artefact reduction sequence.

morphological imaging, providing guidance on the use of most relevant functional imaging, such as 18-Fluoro-deoxyglucose positron emission tomography (18-FDG-PET) and SPECT-CT would provide clarification.[22]

3.2. Trauma reporting

For imaging of trauma patients, it is essential that the correct sequence and imaging planes are obtained for it to be of diagnostic value and aid the clinician in planning treatment.[23,24] The report should aim to provide a diagnostic opinion, and phrases like 'please correlate clinically' should be avoided.[25] A structured report (in comparison to a free text) is preferable to avoid missing out subtle but important findings. For instance, structured reports could help to identify non-contiguous injuries in trauma patients.[16,26] For soft tissue trauma, the grading of ligament injuries is paramount in deciding treatment, and hence where possible, quantify the extent of injury. A recommendation for additional imaging (if there is a high degree of diagnostic uncertainty) would be useful. E.g. In case of doubtful femoral neck fracture an additional imaging such as MRI should be offered in the report. Recommendations in the report should be unambiguous and pragmatic.[27]

3.3. Tumour reporting

The ideal radiology report for cases with suspected MSK tumours should lessen diagnostic uncertainty and avoid ambiguity whenever possible. In addition to describing the morphological characteristics of the suspected lesion, the report should provide, where applicable, a differential diagnosis and advice on further imaging to confirm the suspected diagnosis. Information on the amenability of a lesion to image guided biopsy (USS or CT) can be extremely valuable in planning management. Proactive review of previous imaging for comparison, particularly in equivocal cases including the full area above and below the joint, giving a good comparison or as a post response to chemotherapy will help in decision making process. It is important that every MSK oncology report includes the involvement of extents of bone/joint, neurovascular structures - whether abutted/infiltrated/encased (and to what extent). The description and size of the tumour measured in all three dimensions. The tumour location in relation to the fascia (superficial or deep), compartment involvement, and satellite/skip lesions if any is crucial in the report.[28] This will guide surgeons to plan biopsy and future management. A separate description is anticipated in terms of marrow disease, periosteal reaction, and soft tissue extent from an anatomical landmark. The measurement scale can be highlighted in reporting images. Incidental findings are common in the axial and distal extremities radiograph. Approximately one-third of incidental findings are suspicious for possible malignancy or metastases. Additional diagnostic workup with focused imaging could be offered in the report to guide surgeons for the proper diagnosis.[29] Second opinion from sub-speciality MSK radiologist can be extremely helpful in clarifying clinically significant discrepancies in tumour radiology reporting.[30]

3.4. Post-operative orthopaedic imaging

The spectrum of orthopaedic radiology reporting is changing in post-operative evaluation of patients with metalwork, implants and prosthesis (Table 4). Radiography, currently the standard for postoperative fracture healing evaluation is limited by overlapping bone and hardware.[31] Tomosynthesis and 3D CT in defining skeletal complications of orthopaedic hardware in the postoperative patient is increasingly being considered.[32,33] Similarly MRI has evolved into a robust diagnostic tool for the evaluation of hip arthroplasty implants. Optimized conventional pulse sequences and MARS imaging technique can reveal improved depiction of bone, implant-tissue interfaces, and periprosthetic soft tissue for the diagnosis of arthroplasty-related complications. This will be hep in the decision-making algorithm for management of these complex clinical situations and revision surgery.[19–21,34]

4. Abbreviations and acronym use in radiology reporting

There are several accepted abbreviations that are used in Radiology reporting but should be diligently according to guidelines. A list of commonly used and standardised abbreviations have been published by National and International radiology associations.[35,36] Abbreviations encountered in health literature such as (PACS= Picture Archiving and Communication System. A computer system for providing filmless radiology) make communication faster and provide linguistic guidelines.[37]

5. Use of trauma and orthopaedic classifications in radiology reporting

Orthopaedic surgeons utilize various classifications to understand and guide management of patients. These trauma and orthopaedic classifications help in the pre-operative and intra-operative surgical planning to achieve best patient related outcomes (PROMS). For e.g. Latest orthopaedic surgical literature emphasizes principles of a three-column approach to manage the treatment of tibial plateau fractures.[38] Such classifications or classical radiological 'signs' are also useful in guiding management in patients being monitored for orthopaedic conditions.[39–41] Consequently incorporating elements of traditional or new validated classification systems/radiological signs into radiology reports will enhance radiologists' descriptions of these injuries or pathologies. This will subsequently support clinical decision-making process.

6. Conclusion

Primarily, the aim of a radiology report is to deliver timely, accurate, and actionable information to the referrer, patient and their care team. A quality report provides supporting evidence in the clinical management of patients. It correlates with the patient's clinical situation and provides a suggestive diagnosis or a list of differential diagnoses with a suggestion of appropriate further imaging or investigation. However, it is imperative that the referring clinician indicates the pertinent query they would like answered. This will allow focused reporting on the part of the reporting Radiologist. An effective radiology report, communicated with clarity, will help the referring surgeon in the decision-making process of their patients.

Author's contributions

KPI involved in Conceptualization, literature search, manuscript writing and editing. VN/VKJ/NA/ZH in Literature search, methodology, Data curation, manuscript review and editing. CS supervised overall submission and approved final draft. All authors read and agreed the final draft submitted.

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Statement of ethics

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