

WHITE PAPER

From “Back Pain” to a Working Diagnosis

A spine surgeon’s case for standardized clinical context in musculoskeletal imaging referrals

Authored by

Michael Venezia, DO, MPH

Spine Surgeon, Florida Orthopedic Institute, BayCare Health System · OrthoPoP Clinical Advisor

With clinical commentary from

Jayson Lord, MD

Diagnostic Radiology, BayCare Health System · Interpreting Radiologist, Targeted Overread

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Executive Summary

Musculoskeletal (MSK) imaging is one of the highest volume and most clinically consequential areas in modern radiology, but it is also one of the most exposed to a costly disconnect: the ordering clinician often knows the clinical story, while the interpreting radiologist receives only a limited fragment of it. Across multiple peer reviewed studies, more than 70% of imaging requisitions are graded inadequate, and lumbar MRI in particular shows interpretive miss rates approaching 44%, with disc herniation specifically missed in nearly half of reads when clinical context is absent (Abedi et al., 2019; Castillo et al., 2021; Herzog et al., 2017; Lacson et al., 2018).

The clinical principle behind that data is simple. **In musculoskeletal disease, and especially in compressive neurologic disease of the spine, earlier accurate diagnosis produces better outcomes.** When surgery is truly indicated, closing this information gap can mean a faster route to definitive care, fewer months lost to ineffective conservative treatment, less neurologic deterioration, reduced chronic pain, and lower long-term cost. In MSK care, shortening the time between symptom onset and an actionable diagnosis is not merely an efficiency gain; it is a clinically meaningful intervention that can positively change the outcome.

This white paper presents a single, unusually instructive case: a patient who presented to the emergency department with sudden onset and debilitating left hip pain, quadriceps weakness and medial knee numbness. After radiographic studies ruled in the ED out bony pathology, the patient was provided with muscle relaxer and pain medications and instructed to follow up with his primary care physician for further treatment. In this case, the original lumbar MRI was ordered with the nonspecific indication “back pain.” The initial read provided by the MSK trained radiologist missed the key pathology entirely: a sequestered disc fragment compressing the L3 dorsal root ganglion. Yet the clinical picture was classic for L3 radiculopathy, including anterior thigh pain, medial knee paresthesia, quadriceps weakness, diminished patellar reflex, and a positive femoral nerve stretch test. The level was later confirmed by a positive fluoroscopically guided selective L3 nerve root block. Once the patient completed OrthoPoP’s Regional Pain Module, the structured symptom pattern pointed directly to L3 as a “likely condition”. A targeted overread was then performed by a different MSK trained radiologist who was fully aware of this new clinical context who identified the missed lesion within minutes. Due to the severity of the lesion, the patient then underwent transforaminal endoscopic decompression, removing the infringing fragment from beneath the dorsal root ganglion without facet resection, preserving the L3/L4 motion segment, and avoiding the fusion that traditional open exposure would almost certainly have required. His recovery has been nearly complete.

OrthoPoP is a clinical decision support tool built by practicing orthopedic and spine specialists. It captures a patient’s specific subset of symptoms using a unique anatomic model and a set of site specific questions that change algorithmically based on the patient’s responses. It then applies specialist derived AI matching to generate a ranked set of likely conditions tied to that symptom pattern. The output is the structured clinical context that radiology has needed and has not had a workable upstream way to obtain.

The argument advanced here, from the spine surgeon’s perspective and with input from the interpreting radiologist who completed the targeted overread, is that **structured, standardized capture of the patients orthopedic symptoms, regional pain and neurologic distribution at the point of order, not at the point of read, is the single highest leverage change available to MSK radiology today.** OrthoPoP’s Regional Pain Module is one operational implementation of that change.

1. The Hidden Friction in MSK Imaging Referrals

Every spine surgeon and every musculoskeletal radiologist has lived this scenario. A study arrives in the worklist with an indication that reads “*back pain*,” “*leg pain*,” “*rule out pathology*,” or, on a bad day, a single generic ICD code copied from a problem list. The referring clinician knows much more than that. The patient knows much more than that. Almost none of this clinically relevant information travels with the study order.

This is not a documentation failure by any individual. It is a structural problem produced by three converging realities of modern care delivery.

1.1 The EHR and PACS divide

Most physicians work inside an electronic health record. The EHR is where they document the history, physical examination, working differential, and rationale for ordering imaging. Radiologists, however, increasingly practice outside that same clinical environment. A growing share of MSK imaging is interpreted remotely, where the radiologist's primary workspace is the picture archiving and communication system, or PACS, rather than the referring clinician's EHR. That creates a critical divide. Imaging lives in the PACS, while clinical context lives in the EHR. The two systems are rarely connected in a way that places the relevant clinical narrative in front of the radiologist at the moment of interpretation. As a result, the handoff is often reduced to a single requisition field, and that field is expected to carry the entire clinical story.

1.2 The billing constraints on what an order can say

MRI is most valuable when it is used to confirm, refine, or localize a suspected diagnosis. It should not be treated as a broad screening tool. Without a clear clinical question, even high-quality imaging can produce low-value interpretation. But the order itself requires a coded diagnosis to be approved and billed, and **most payers do not recognize “rule out” language as a billable indication as they do not typically cover “screening” examinations.** A clinician may have a highly specific working concern, such as possible L3 nerve root compression from a disc herniation. But because that diagnosis has not yet been confirmed, the imaging order is often submitted under a generic code like “back pain.” As the order moves from the EHR into the PACS environment, any additional clinical nuance written into the script or note is frequently lost or diluted. By the time the study reaches the radiologist, the order may contain only the nonspecific coded indication, while the clinician's actual clinical hypothesis or “working diagnosis which is greatly influenced by the patient's presenting symptoms, the very question the MRI was meant to answer, is not accessible by the reader who is actually tasked with moving the patient from an “unknown” condition to an accurate and actionable diagnosis. This creates an important irony. The generic coding that often helps a diagnostic study get approved may be the same thing that strips the order of the specificity needed to guide interpretation. Later, when treatment is considered, the system often demands the very specificity that was missing at the imaging stage. That mismatch makes the handoff even more consequential: the ordering clinician, radiologist, and treating specialist may be working across different documentation environments and different insurance rules, but the patient's outcome depends on whether the original clinical question is preserved.

1.3 The lost handoff at the imaging facility

At the imaging facility, the patient may be asked about symptoms during intake, but that information rarely reaches the radiologist in a usable form. The radiologist typically receives the order, the coded indication, and the images, not the patient's description of pain, symptom distribution, neurologic findings, or the clinician's working differential. Without that context, the radiologist is not being asked to prove or disprove a specific diagnostic hypothesis. They are being asked to perform a broad inspection of the study. That distinction matters. A focused clinical question changes the read. It tells the radiologist where to look, what to test against the images, and which subtle findings may carry clinical significance. Without it, the study becomes more like a haystack, where the diagnostic needle is buried. The radiologist can still identify obvious abnormalities, but subtle pathology in a specific anatomic corridor is easier to miss because no one has identified the "needle" they are supposed to find. In that setting, the rational interpretive strategy becomes a generic multipoint survey: scan broadly, document the conspicuous, and move on. The radiologist is not honing in on a specific pain generator because the system has failed to tell them one is suspected.

These three structural gaps are not anecdotal. In a structured review of more than 300 lumbar MRI and CT abdomen and pelvis orders at a tertiary academic center, 81% of requisition indications were incomplete relative to the referring provider's own notes, and 42% were directly discordant with those notes (Lacson et al., 2018). A recent application of the Reason for Exam Imaging Reporting and Data System, a published grading framework for radiology requisitions, to nearly 1,300 emergency department CT requisitions found that fewer than 28% reached the threshold of "adequate" or "barely adequate" clinical reasoning (Abedi et al., 2019). A systematic review concluded that the provision of clinical information at the time of interpretation, not retrospectively, measurably improves diagnostic accuracy, with reported interpretation changes in 38% to 43% of cases when context is added (Castillo et al., 2021; Loy & Irwig, 2004). The downstream effect is predictable: communication breakdown is the second most common contributor to diagnostic error in radiology malpractice claims, appearing in roughly 22% of paid claims (Bruno et al., 2015).

A radiologist working from "back pain" as the entire clinical input is not necessarily missing the diagnosis through inattention. They are being handed the wrong question. Instead of being asked to evaluate a suspected L3 radiculopathy, they are being asked to perform a broad survey for back pain. That difference can determine whether a subtle but clinically decisive finding is recognized or overlooked. That is not under-reading. It is reading the wrong question.

2. The Clinical Stakes: Why “Back Pain” Is Not Enough

Lumbar MRI is the imaging study most likely to be ordered for an MSK complaint and one of the most likely to be misread. In a landmark study, the same patient with confirmed lumbar pathology was sent to ten different MRI centers within a window of three weeks. Across those ten reads, the average interpretive miss rate was 43.6%, and the average miss rate specifically for disc herniation was 47.5% (Herzog et al., 2017). Interrater agreement on the presence of a herniation, by Fleiss kappa, was effectively zero.

Importantly, this variability is not eliminated by experience alone. In a dual read study of 59 patients with lumbosacral radicular pain, two experienced neuroradiologists evaluated each lumbar segment twice, once blinded to clinical history and once with it disclosed. Disclosure of clinical information improved agreement on nerve root compression and shifted interpretations on a clinically meaningful proportion of segments (van Rijn et al., 2005). The radiologists were not less skilled in the blinded read; they were less directed.

The pathology that hides best is exactly the pathology that needs context. Sequestered (free fragment) disc herniations are often lentiform on sagittal images and easy to overlook on axial sequences if the slice is angled to the disc rather than stacked through the canal. Foraminal and extraforaminal herniations sit lateral to the territory most commonly scrutinized. Intradural disc fragments require recognition of an unusual morphology and prompt the surgeon to plan a durotomy (Crim, 2023). In all of these cases, clinical context, *where* the patient hurts, *what* the dermatomal pattern is, *which* motor groups have failed, changes the read more than any incremental improvement in scanner hardware ever will.

The cost of missing these findings is measured in time. In lumbar disc herniation with radiculopathy, the duration of nerve root compression correlates with the probability and completeness of recovery; prolonged compression is associated with worse motor and sensory outcomes (Kreiner et al., 2014). **Earlier accurate diagnosis is not a workflow nicety. It is a clinical determinant of how well the patient does in regards to the long-term outcome.**

From the Reading Room: A Radiologist's Note

*“When the only indication is ‘back pain,’ the read defaults to a survey. We document what is conspicuous, disc desiccation, prior surgical changes, gross stenosis, and we move on. We are trained to do this efficiently because the worklist volume is unforgiving. **When the order***

tells me a patient has new L3 distribution weakness with anterior thigh and medial knee pain, the read is no longer a survey. It is a directed search for L3 nerve root pathology, and the foraminal and far lateral spaces become primary territory rather than peripheral.” Dr. Jayson Lord, Radiology

This shift is well described in the cognitive science of radiologic search. **Satisfaction of search**, the documented decrease in vigilance for additional findings after a first abnormality is identified, has been cited as a contributor in roughly 22% of classified diagnostic errors (Busby et al., 2018). When prior surgical change at L5/S1 is the most conspicuous abnormality on a study and the indication is generic, the L3 level finding can fall into exactly the blind spot the literature predicts (Itri & Patel, 2018).

3. Case Presentation: When an App Developer Becomes the Patient

3.1 Background

Dr. Adam Perler is a cocreator of OrthoPoP and was, at the time of this presentation, a working physician with a remote history of significant lumbar trauma. As a college student at Indiana University, he was struck by a car while training for the Little 500 and sustained extensive L5/S1 injury that ultimately required two surgeries spread out over a 20 year period. The first addressed left-sided radiculopathy in the L5/S1 distribution and the second, several years later, to address an acute on chronic disc rupture on the right side with both a neritic pain component and sudden onset weakness of the glutes and ankle flexors. He avoided fusion on both occasions and had been functionally well for over 10 years prior to this most recent event.

3.2 Presentation

In September 2025, while presenting OrthoPoP at the AI4 conference as a new startup vendor, Dr. Perler’s back symptoms (primarily pain in the lower back, but without radiation) recurred. After a red eye return flight home to Florida, he rested a bit when he arrived home and when he stood up **his left leg gave out**. He immediately experienced pain radiating to the left hip. He presented that same evening to a BayCare emergency department due to the unrelenting pain as he was concerned he may have sustained a fracture since the symptoms were drastically different than what he had experienced in the past with his lower lumbar issues. Examination at presentation, when retrospectively reconstructed from the chart and the patient’s own account, was a textbook L3 syndrome: severe anterior thigh pain extending into the medial knee, paresthesias in an L3 dermatomal distribution, frank quadriceps weakness (graded 3/5 on knee extension), a diminished patellar reflex, and a positive reverse straight leg (femoral nerve stretch) maneuver. To any spine

surgeon evaluating the patient at the bedside, this is not a vague “back pain” presentation. It is a localizing, level specific neurologic deficit that points to compression of the L3 nerve root and demands directed imaging at the L2/L3 and L3/L4 segments. An MRI of the lumbar spine was ordered.

The clinical indication transmitted to radiology was: “*back pain.*” No mechanism, no point of pain, no symptom distribution, no neurologic exam findings. No mention of the new lower extremity weakness, the dermatomal pattern, or the prior L5/S1 surgical history. The order followed exactly the path described in Section 1: a coded, generic diagnosis on the requisition; an EHR full of context the radiologist would never see; and an intake conversation at the imaging facility that did not propagate to the read.

3.3 The First Read

The interpreting radiologist read the study broadly. The prior L5/S1 surgical changes, chronic, conspicuous, and consistent with the limited indication provided, were documented. The study was cleared. **A ruptured disc fragment compressing the L3 nerve root was not identified.**

This is exactly the failure mode the literature predicts. With a generic indication and a conspicuous prior abnormality, the radiologist had no reason to redirect search to the L3 level, and the fragment, a sequestered, lentiform configuration of the type Crim (2023) specifically catalogs as easily missed, sat in a region of comparatively lower attention. This is not interpretive failure in isolation; it is the predictable consequence of an upstream information failure. What was missed in this case was not a small annular bulge. It was a true sequestered fragment that had migrated into the lateral recess and foramen and had come to rest directly on the L3 dorsal root ganglion (DRG). The DRG is uniquely susceptible to mechanical compression: it is densely populated with sensory cell bodies, has an incomplete blood-nerve barrier, and responds to direct pressure with disproportionate inflammatory and nociceptive signaling. That is the surgical correlate of why this patient presented not with mild radiculopathy but with severe, treatment refractory anterior thigh pain and an acute motor deficit. Fragment volume alone does not explain that clinical picture; fragment location on the DRG does.

3.4 The Structured Reframe

Within hours, Dr. Perler completed OrthoPoP’s Regional Pain Module on his own case. The Regional Pain Module was designed by spine specialists to capture a pattern that is often poorly represented in traditional intake workflows: referred pain. In compressive neurologic disease, pain frequently does not present as a single isolated point. It travels along a nerve distribution. For that reason, OrthoPoP does not force every patient into a single point of pain response. If the patient has a true focal pain generator, they can mark it directly. But when the pain follows a regional or dermatomal pattern, as is common in radiculopathy, the module captures the full distribution. That distinction is critical. In neurologic conditions, the pattern of referred pain is often the

diagnostic key. If that pattern is not captured accurately, the rest of the differential is built on weak input.

The Regional Pain Module captures structured information on:

- the anatomic point or field of pain, whether focal or referred
- the radiation pattern mapped against dermatomal territory
- mechanism and onset characteristics
- associated motor and sensory findings
- a ranked set of likely conditions tied to the patient's specific symptom pattern, which the imaging study is then expected to confirm or refute

In Dr. Perler's case, the pain map was unambiguous. His symptoms tracked through the anterior thigh and medial knee, with associated quadriceps weakness. That is a classic L3 pattern, not L5 or S1. The structured differential generated by the module placed acute foraminal or extraforaminal disc herniation at L2/L3 or L3/L4 with L3 radiculopathy near the top of the list.

From a spine surgeon's standpoint, that constellation is nearly diagnostic before the image is even reviewed. The L3 dermatome involves the anterior thigh and medial knee. The L3 myotome contributes substantially to hip flexion and knee extension through the quadriceps. The L3 reflex arc is reflected through the patellar tendon. A patient presenting with anterior thigh pain, medial knee paresthesia, weak knee extension, diminished patellar reflex, and a positive femoral nerve stretch test should be treated as an L3 radiculopathy until proven otherwise. Just as important, there was no meaningful L5 or S1 finding in the clinical picture. That is why anchoring on the patient's prior L5/S1 surgical history would have been a clinical mistake. The old abnormality was conspicuous, but it did not explain the new deficit.

To formally confirm the level before operative planning, a fluoroscopically guided selective L3 nerve root block was performed. Contrast challenge fully reproduced the patient's anterior thigh and medial knee pain. Local anesthetic then transiently abolished it. That response was unequivocally positive and closed the diagnostic loop. By that point, the case had three independent but concordant data points: the structured symptom map generated by OrthoPoP, the lesion identified on targeted imaging overread, and the positive selective L3 nerve root block. The symptom pattern, the imaging finding, and the confirmed pain generator all pointed to the same answer: L3 nerve root compression.

3.5 The Targeted Overread

Armed with the structured pain distribution and ranked differential generated by OrthoPoP, a colleague performed a targeted overread of the same MRI. This time, the ruptured disc fragment compressing the L3 nerve root was identified on the sagittal sequence, precisely at the level the

structured clinical context had nominated. Dr. Perler reviewed the findings with me directly. At that point, the next decision was operative planning, and it was not a trivial one.



Figure 1. Sagittal lumbar MRI on targeted overread. The sequestered disc fragment compressing the L3 nerve root (highlighted) was identified at the level the structured clinical context had nominated. The same fragment was present on, but not identified by, the original generic-indication read.

A foraminal or extraforaminal sequestered fragment seated directly on the L3 dorsal root ganglion occupies one of the most surgically unforgiving locations in the lumbar spine. Far lateral and extraforaminal disc herniations account for only 7 to 12 percent of lumbar disc herniations, but they are disproportionately difficult to access through traditional posterior corridors. The lamina, pars, and facet complex obstruct direct visualization of the lateral recess and foramen, making exposure both technically demanding and potentially destabilizing.

Using a traditional open or minimally invasive tubular approach, adequate access to a fragment in this location often requires partial or complete resection of the ipsilateral facet joint. That matters because iatrogenic facet compromise is well documented as a contributor to segmental instability and, in some cases, the need for instrumented fusion. Some institutional series have even adopted unilateral full facetectomy with instrumented fusion as the standard primary operation for foraminal and far lateral herniations, underscoring how easily this anatomy can push the surgeon toward fusion when conventional exposure is used.

In a young, athletic patient with an already compromised L5/S1 segment, destabilizing L3/L4 would have carried significant long term consequences. It would likely have committed him to an instrumented transforaminal or lateral interbody fusion at that level. That is a very different operation: more soft tissue dissection, longer recovery, increased adjacent segment loading on a spine with prior surgery below, and permanent loss of motion at L3/L4. We elected instead to use a transforaminal endoscopic approach.

With current generation endoscopic spine technology, the fragment was reachable through a small lateral working portal under continuous fluoroscopic guidance and direct endoscopic visualization. No facet resection was required. The posterior tension band was not violated. The L3/L4 motion segment was preserved entirely. The intraoperative finding was striking and worth reporting in detail. On entry into the foramen, the L3 dorsal root ganglion was identified as expected, but the main body of the sequestered fragment was not visible within the foramen itself. It was hidden directly beneath the DRG, tucked into the lateral recess and ventral to the ganglion, exactly where it had been compressing the nerve throughout the patient's symptoms. Removal required careful piecemeal decompression. The DRG was gently and atraumatically mobilized superiorly. The fragment was delivered from beneath the ganglion in small bites using endoscopic graspers, with meticulous avoidance of traction, thermal injury, or disruption of the perineural blood supply. That caution was essential. The DRG tolerates compression poorly and surgical traction even less well. A single careless pull in that location can produce a permanent burning dysesthesia that may be more disabling than the original radiculopathy.

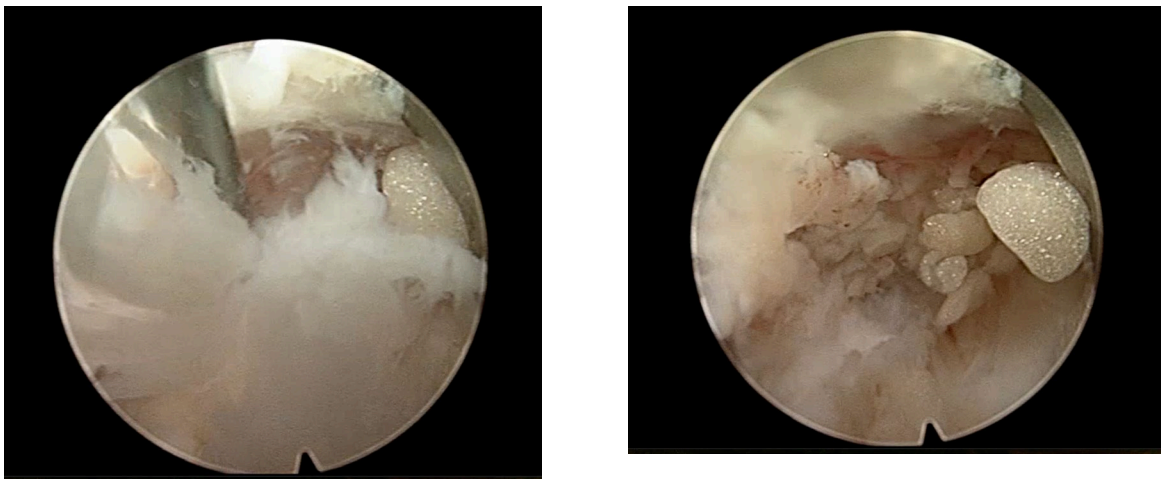


Figure 2. Transforaminal endoscopic intraoperative views. Left: the L3 dorsal root ganglion in the foramen, with the sequestered fragment concealed beneath and ventral to the ganglion. Right: the fragment after atraumatic mobilization of the DRG, prior to piecemeal extraction with endoscopic graspers. The L3/L4 motion segment was preserved and no facet resection was required.

By the end of the procedure, the L3 nerve root and DRG were freely mobile, well perfused, and decompressed throughout the foraminal course. The patient ambulated the same day. His recovery has been near complete, and the L3/L4 motion segment remains intact. In a patient with

prior surgery at the level below, preservation of that segment is not a technical footnote. It is a meaningful long-term outcome.

The interval matters. The time from presentation to definitive surgical decompression was fourteen days. In a patient who already had objective neurologic compromise, that sits at the favorable end of the outcome window described in the lumbar radiculopathy literature. The longer the interval between symptom onset and decompression, the less predictable full motor recovery becomes.

That is the central point of this case. The structured context did not simply produce the correct diagnosis. It produced an earlier one. In compressive neurologic disease, earlier diagnosis can change not only what is found, but what operation is required, how much anatomy is sacrificed, how much motion is preserved, and determines both the speed and the amount of overall functionality that the patient recovers.

From the Reading Room: The Targeted Overread (Dr. Jayson Lord)

“On the targeted overread, the fragment was visible. But that is the uncomfortable truth of every retrospective review: hindsight bias is real, and a finding is always easier to see once you know where to look. I understood why it was missed on the initial read. The patient had significant pre-existing L5/S1 pathology and a history of two prior operations at that level. With the clinical indication limited to ‘back pain,’ the eye naturally goes to the most conspicuous abnormality and the area that seems most likely to explain the order.

*What changed on the overread was not the MRI. What changed was the clinical question. **The first read was effectively asking, ‘Is there lumbar pathology in a patient with prior surgery?’ The targeted overread was asking, ‘Is there an L3-level structural cause for new anterior thigh pain, quadriceps weakness, and medial knee numbness?’** Those are not the same question. They create different search patterns, different attention maps, and ultimately, different reports.*

The structured input transmitted with the OrthoPoP overread request was not just more information. It was the right information: a localized, dermatome ally consistent clinical hypothesis generated from the patient’s own symptom mapping and the specialist-derived logic behind the Regional Pain Module. That is the kind of clinical context I would want in front of me for every MSK study I read.”

4. The OrthoPoP Approach: Standardizing What the Radiologist Needs

The case above is one data point, but the principle behind it is much broader. In MSK imaging, the quality of the clinical input given to the radiologist can become the rate limiting step in diagnostic accuracy. The literature has repeatedly shown that the relevance, specificity, and completeness of clinical information influence radiologic interpretation, report quality, and downstream clinical decision making. If that is true, then the highest leverage intervention is not to criticize the radiologist after a miss. It is to standardize the clinical question before the read begins.

That is what OrthoPoP was built to do. Designed by practicing orthopedic and spine specialists, OrthoPoP converts patient symptoms, clinician logic, and specialty specific exam patterns into a structured clinical handoff that can travel with the imaging order. It is not simply another digital intake form. Four design choices make it fundamentally different.

4.1 A unique anatomic model with site specific adaptive questions

OrthoPoP does not present patients with a static questionnaire. It begins with an interactive anatomic model and asks the patient to identify where symptoms are occurring. From there, the intake adapts in real time. The next question is determined by the patient's prior response and by the anatomic region selected. A patient who reports anterior thigh symptoms is not asked the same follow up questions as a patient with posterolateral leg pain or lateral hip pain. **Each pathway is designed to narrow the clinical possibilities by asking the next most relevant question for that specific region, symptom pattern, and suspected source.** In this way, OrthoPoP does not simply collect symptoms. It triangulates them.

The result is a structured, standardized symptom profile that is far more specific than a free text indication on an imaging requisition. Instead of reducing the patient to “back pain,” the system can preserve the clinically meaningful pattern: where the pain is, where it travels, what neurologic features are present, and which anatomic sources should be considered during interpretation.

The screenshot shows the 'Explore' interface of the OrthoPoP system. At the top, there is a navigation bar with a back arrow, the title 'Explore', and a close button. Below this, the section 'Condition Questions' is displayed, indicating '3/3 steps'. The questions are listed with checkboxes: 'Did your pain occur without any known trauma?', 'Is your pain worse with range of motion or activity?', 'Does pain feel like it goes up and down your back?', 'Did you have a history of scoliosis when you were younger?', and 'Do you have any difficulty with your posture?'. Below the questions, a 'Matching Conditions' section shows a 'Better Match' bar with four colored segments (green, yellow, orange, red). The conditions listed are: 'Spinal stenosis ICD-10: M48.06', 'Spinal tumor ICD-10: C41.2', 'Lumbar herniated nucleus pulposus - lumbar disc herniation ICD-10: M56.01', and 'Lumbar herniated nucleus pulposus, l3 radiculopathy - lumbar disc herniation ICD-10: M56.01 M54.17'. A 'Proceed' button with a right arrow is at the bottom. A disclaimer at the very bottom states: 'OrthoPoP is not a physician. Please consult your provider. [Learn More](#)'.

Figure 3. OrthoPoP's site-specific adaptive condition questions for the L3 anatomic territory, with the resulting ranked differential. Lumbar herniated nucleus pulposus with L3 radiculopathy (ICD-10 M56.01, M54.17) appears at the top of the “better match” list, generated from the patient's specific symptom subset rather than from a generic free-text indication.

4.2 The Regional Pain Module: capturing referred pain by design

The Regional Pain Module was designed by a spine specialist to solve a specific problem: many patients with compressive neurologic disease do not experience pain as a single anatomic point. In lumbar radiculopathy, pain often presents as a dermatomal territory, with the most intense symptoms occurring downstream from the structural lesion itself. **Forcing those patients to identify one point of pain, as many intake forms do, can distort the clinical picture and create misleading input for imaging interpretation.**

OrthoPoP addresses this by giving the patient a more clinically appropriate choice. If the pain is truly focal, the patient can mark a single point. If the pain is referred, which is common in neurologic conditions, the patient can activate the regional pain map and trace the full distribution. The system then compares that pattern against known dermatomal territories and carries that recognition forward into the downstream differential. That design choice mattered in the case above. The system identified an L3 distribution and generated an L3 level differential, rather than defaulting toward the L5 or S1 pathology that the patient's prior surgical history might have biased a reader to emphasize.

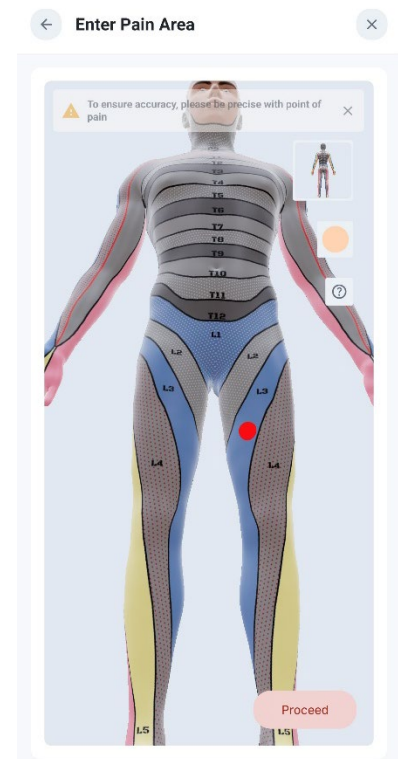


Figure 4. OrthoPoP's Regional Pain Module showing the patient's pain distribution mapped to the anterior left thigh. The dermatomal pattern is captured directly rather than collapsed into a single point of pain, preserving the L3 distribution that drove the downstream differential and, ultimately, the targeted overread.

4.3 Specialist derived AI matching to a ranked differential

The structured symptom pattern is then processed through specialist derived matching algorithms. **These algorithms were built around the diagnostic reasoning patterns of practicing orthopedic and spine surgeons, not scraped from generic medical text.** The goal is not to replace clinical judgment, but to preserve and transmit the kind of focused differential a specialist would want in front of them when reviewing the case.

The output is not a single suggested diagnosis. It is a ranked set of likely conditions tied to the patient's specific symptom subset, with each condition framed as something the imaging study should help confirm or refute. In practical terms, this becomes the structured differential that travels with the imaging request. In the case above, that is what transformed a generic indication like "back pain" into a targeted clinical question: is there an L3 level structural cause for this patient's anterior thigh pain, medial knee sensory change, and quadriceps weakness?

In musculoskeletal disease, and especially in compressive neurologic disease of the spine, earlier accurate diagnosis is not simply a process improvement. It is a determinant of recovery. Every additional week spent on ineffective conservative care is another week with an unrelieved nerve root, another week for motor and sensory loss to progress, and another week for acute pain to become chronic disability.

4.4 Standardization across referrers

Variation in requisition quality is itself a quality problem. A high volume MSK radiologist reads studies ordered by emergency physicians, primary care clinicians, urgent care providers, sports medicine physicians, and orthopedic specialists, each working under different documentation habits, clinical workflows, and time pressures. As a result, the quality of the clinical question sent with the study can vary dramatically before the radiologist ever opens the images.

A standardized regional pain capture helps correct that problem. It allows the imaging request from an emergency department to carry the same structured clinical elements as a request from a spine clinic: anatomic location, symptom distribution, mechanism of onset, neurologic findings, and a focused differential for the study to confirm or refute. That kind of standardization is not just operationally useful. It aligns with the broader direction of radiology quality standards. Professional society communication parameters, including those from the American College of Radiology, emphasize the importance of accurate, relevant clinical information accompanying imaging requests. Published requisition grading frameworks were created for exactly this purpose: to assess whether imaging requests contain the clinical context needed to support meaningful interpretation. (Abedi et al., 2019).

5. Implications for Radiology Practice

This case supports OrthoPoP not because it helped identify the correct diagnosis in one patient, but because it operationalized a solution to a problem the radiology literature has documented for more than two decades: incomplete, inconsistent, and poorly transmitted clinical context at the point of interpretation. Until recently, that problem has lacked a practical upstream solution.

For a radiology department considering structured pre imaging symptom capture for MSK referrals, the implications are concrete. OrthoPoP does not ask radiologists to read more slowly, search harder, or compensate for missing context after the fact. It improves the quality of the clinical question before the images are opened.

5.1 Reduction in interpretive miss rate for high stakes pathology

The Herzog et al. (2017) finding of a 47.5% miss rate for disc herniation across centers should be understood as a department-level vulnerability, not simply an individual reader problem. In high-volume MSK imaging, misses are often shaped by workflow, incomplete clinical context, and nonspecific requisitions before the radiologist ever opens the study. Standardized clinical context addresses that upstream failure point by narrowing the search field and giving the reader a specific diagnostic hypothesis to test, and is the single intervention shown to improve interpretation accuracy by 8 to 12 percentage points in head-to-head comparisons (Castillo et al., 2021). For a department reading thousands of lumbar MRIs annually, even a modest absolute improvement represents a non-trivial reduction in missed clinically significant findings.

5.2 Mitigation of well documented cognitive biases

Satisfaction of search, anchoring, and inattentional blindness are not character flaws. They are predictable cognitive load responses in a high-volume worklist environment (Bruno et al., 2015; Busby et al., 2018; Itri & Patel, 2018). Structured clinical input does not eliminate these biases, but it changes the diagnostic prior that guides the search. That matters because, outside of double reads, improving the clinical context provided to the radiologist is one of the few interventions with consistent empirical support. Double reads may reduce error, but they are difficult to scale across routine MSK volume. Standardized input is scalable.

5.3 Bridging the EHR and PACS divide

Because OrthoPoP captures structured clinical context as a discrete artifact that can travel with the imaging order, it creates a practical bridge between the system where the clinical narrative lives, the EHR, and the system where interpretation occurs, the PACS. This is especially important for remote radiologists, who may have little or no direct access to the referring facility's EHR. Instead of seeing only the order, the coded indication, and the images, the radiologist can review the structured pain map, symptom distribution, neurologic findings, and ranked differential at the point of interpretation. In practical terms, OrthoPoP closes the information gap described in Section 1 at the exact workflow moment where that gap is most consequential: when the radiologist opens the study and decides what question the images are being asked to answer.

5.4 Defensible documentation and reduced repeat imaging

When clinical context is structured and available at the time of interpretation, the radiology report can directly answer the referring clinical question. Findings can be correlated to the patient's symptom distribution, neurologic pattern, and working differential, producing a report that is more clinically useful and more defensible. It also reduces the need for vague "clinical correlation

suggested” language, which can contribute to uncertainty, repeat imaging, delayed treatment decisions, and friction in the billing and reimbursement process.

5.5 Earlier diagnosis as the underlying clinical goal

Each of these operational improvements serves one clinical purpose: **shortening the interval between symptom onset and a correct, actionable diagnosis**. In compressive neurologic disease of the spine, that interval is not just an administrative metric; it is a determinant of recovery (Kreiner et al., 2014). A standardized, structured input that converts a broad survey into a directed read functions, in clinical terms, as an interval compression tool.

The downstream value is not measured only in radiology performance metrics. It is measured in earlier diagnosis, faster definitive treatment when indicated, improved motor recovery, reduced risk of chronic pain, and patients who return to function sooner.

6. Limitations and Honest Counterpoints

A single case, however striking, is not evidence of program-level effectiveness. Several legitimate counterpoints deserve to be stated directly.

First, the radiologist on the original read was not negligent. Given the clinical indication provided, the interpretation was defensible. Any serious effort to improve this failure mode has to begin there. The argument is not that radiologists simply need to read better. It is that they need to be asked the right question.

Second, structured intake adds friction at the point of order. The practical question is whether that added step is outweighed by downstream gains in interpretive accuracy, fewer missed findings, fewer repeat studies, and faster clinical decision making. The published literature on requisition grading frameworks and computerized requisition systems with required history fields suggests that this tradeoff can be favorable when the tool is integrated into workflow rather than bolted onto it (Abedi et al., 2019). But that outcome is not automatic. It has to be implemented well and measured.

Third, patient-reported regional pain data has real limitations. Patients with nonorganic pain, somatization, overlapping pain generators, poor recall, or atypical presentations may produce maps that do not correspond cleanly to a dermatomal or anatomic pattern. A structured tool is most useful when it surfaces those discordances explicitly, rather than masking uncertainty behind a confident-looking differential. OrthoPoP’s module is designed to flag low-confidence patterns, but this remains a real and ongoing design challenge.

These caveats sharpen the argument rather than weaken it. The case for standardized clinical context in MSK imaging does not depend on perfection. It depends on comparison to the current

default: free-text indications that are often reduced to a single phrase, may be incomplete or incorrect, and frequently fail to carry the clinical question the imaging study was ordered to answer. Against that baseline, a structured alternative is not merely cleaner documentation. It is a more reliable handoff.

7. Conclusion

The patient in this case had three advantages most patients do not. He was a physician. He was a co-creator of the structured intake instrument that ultimately helped redirect his diagnosis. And he had direct access to both a spine surgeon and a radiologist who understood the logic behind that instrument. **Most patients have none of those advantages.**

That is the point of OrthoPoP: to make the diagnostic pathway he experienced less dependent on personal access, insider knowledge, and clinical happenstance with a directed read, accurate localization of symptoms, definitive surgery within fourteen days and a near complete recovery. Those should not be exceptions reserved for patients who know how to navigate the system. They should become the default pathway whenever the clinical pattern supports it.

In musculoskeletal disease, and especially in compressive neurologic disease of the spine, earlier accurate diagnosis is not simply a process improvement. It is a determinant of recovery. Every additional week spent on ineffective conservative care is another week with an unrelieved nerve root, another week for motor and sensory loss to progress, and another week for acute pain to become chronic disability. Compressing the interval between symptom onset and an actionable diagnosis is the clinical job. Structurally, OrthoPoP is an interval compression tool. It captures the patient's specific symptom subset, applies specialist derived logic through a unique anatomic model and adaptive site-specific questioning, and delivers the radiologist the structured clinical context needed to turn the read from a broad survey into a directed search.

From the spine surgeon's side of the table, the case for standardized clinical context in MSK imaging is direct. I want my radiology colleagues working with the same structured information I have when I evaluate the patient in clinic. I want them asked a localized, dermatomally consistent question instead of being handed "back pain." I want the read directed to the territory the history and examination have already identified. When that happens, missed findings like the one described in this paper become less likely, surgical timing improves, and patients have a better chance of recovering function they might otherwise lose.

OrthoPoP is one operational implementation of that change. The broader principle is bigger than any single platform: the input to the radiologist is one of the highest leverage variables in MSK imaging accuracy. That principle is supported by two decades of peer reviewed evidence. For

radiology departments, the question is no longer whether MSK referral context should be standardized. The question is how quickly they can make it happen.

*The first read was answering 'is there back pathology in a patient with prior surgery?'
The targeted read was answering 'is there an L3 level structural cause for new
anterior thigh weakness?' Those are not the same study.*

Jayson Lord, MD, Radiology

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