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From Correct Answers to Defensible Decisions: Learning by Concordance in Orthopaedic Education

Jeff Walter Rajadurai OR[1,2*], P. S. Manoharan[3], P Shanmuga Sundaram[4], Deepak Nallaswamy[5]

1- PhD in Health Professions Education, Saveetha Institute of Medical and Technical Sciences, Saveetha university, Chennai,India,
2- Associate Professor, Department of Orthopaedics, Madha Medical College & Research Institute, Chennai,India.
3- Professor, Department of Prosthodontics and Crown & Bridge, Associate Dean Academics, Saveetha Dental College, Programme Director, Health Professions Education, Saveetha Institute of Medical and Technical Sciences, Chennai,India.
4-Department of Orthopaedics, Madha Medical College and Research Institute, Chennai, Tamil Nadu, India.
5- Professor in Prosthodontics and Pro Chancellor, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai,India.

ABSTRACT
Traditionally orthopaedic postgraduate education has been focused on knowledge acquisition, case discussions, workplace-based assessment and progressive operative responsibility. These approaches are essential, however many assessment formats still lean toward identification of a single correct answer. In orthopaedics, the clinical practice is different. In many decisions; operative versus non-operative treatment, choice of fixation, reconstruction versus replacement, timing of surgery, and the degree of trainee supervision-judgement is often required under uncertainty. Learning by Concordance (LbC) is an educational technique where learners are presented with authentic clinical scenarios and asked to respond. Their decisions and reasoning are then compared with those of a panel of experts. Instead of requiring uniformity of opinion, LbC exposes learners to the ways in which experienced clinicians interpret uncertainty and construct defensible decisions. This Short Communication addresses the possible use of LbC in orthopaedic postgraduate education. Recent evidence supporting the use of Script Concordance Testing in surgical and orthopaedic residents provides a specialty-specific rationale for this approach. We propose that LbC could be used to enhance traditional teaching by providing structured case-based reasoning in trauma, arthroscopy, arthroplasty and other areas where there may be more than one reasonable pathway of management. The possibility of extending it to Entrustable Professional Activities (EPAs) and faculty calibration is also discussed. Further prospective studies are needed to establish its educational effectiveness in orthopaedic training.
Keywords: Clinical reasoning; competency-based medical education; entrustable professional activities; learning by concordance; orthopaedic education; postgraduate education; script concordance.

I. INTRODUCTION

Beyond the Single Correct Answer

Orthopaedic postgraduate training is organised around the gradual accumulation of knowledge, clinical judgement and technical competence. Written exams and traditional case-based testing are appropriate for determining whether trainees know established principles and safe standards of care. In practice, however, this is often not the case. The surgeon may have to select from several reasonable options rather than find one clearly correct answer.

Does non-operative treatment, internal fixation or arthroplasty benefit elderly patients with displaced proximal humeral fractures? ACL revision with tunnel widening: single stage or staged reconstruction? When is fracture morphology a guide to operative fixation despite seemingly acceptable radiographic parameters? These decisions cannot always be reduced to the binary categories of right and wrong. They are based on clinical evidence, patient characteristics, anatomy, functional expectations, available expertise and the surgeon's interpretation of risk.

In the face of such uncertainty, therefore, clinical reasoning is an important element of specialist development. Script Concordance Testing (SCT) was developed to study reasoning in situations where information is incomplete or uncertain and expert clinicians can legitimately disagree in their judgements [6,7]. Concordance-based learning (LbC) moves the principle from assessment to education by revealing the reasoning of the expert to the learner [1-4].

The distinction is an important one for orthopaedic education. The aim is not to substitute opinion for evidence-based standards, but rather to educate

trainees about how evidence, experience, and contextual factors are synthesised when a single predetermined answer does not adequately encapsulate clinical practice.

What Is Learning by Concordance?

LbC is an instructional strategy based on cases that is intended to develop professional reasoning. Learners are presented with real clinical scenarios that require interpretation or decision-making. Once they make a decision on a response, they compare their decision with responses from a reference panel of experienced professionals. Importantly, learners are also exposed to the rationale provided by individual panel members, as well as a synthesis of the key learning points [1].

This approach was derived from concordance-based assessment and SCT. SCT measures how well the learner's reasoning matches the pattern of judgements made by an expert reference panel [6,7]. LbC adds an explicit educational component: experts explain their decisions. Therefore, disagreement between experts can become a material for education by itself rather than statistical noise [1-3].

Early uses showed the viability of using this approach to introduce learners to the complexity and uncertainty of clinical practice [2]. Later work has provided more detail on the design of LbC cases and how expert explanations can be incorporated into instruction [3]. A recent scoping review identified 28 primary studies involving LbC and concluded that the approach is promising for developing decision-making in uncertain clinical contexts, although there is still considerable methodological heterogeneity [4]. Recent work with electronic LbC has also explored the role of the LbC in improving clinical reasoning [5].

Table 1 provides a summary of the differences between conventional assessment, SCT and LbC.

Table 1. Comparison of conventional clinical teaching, Script Concordance Testing and Learning by Concordance

Feature	**Conventional single-best-answer approach**	**Script Concordance Testing**	**Learning by Concordance**
Primary purpose	Knowledge/application assessment	Assessment of reasoning under uncertainty	Development of reasoning under uncertainty
Clinical problem	Usually structured with a preferred answer	Uncertain or ambiguous clinical situation	Authentic uncertain clinical situation
Expected response	One best answer	Judgement compared with expert-panel responses	Decision followed by comparison with expert decisions and reasoning
Role of experts	Define the correct answer	Generate the reference response distribution	Provide responses **and explain their reasoning**
Expert disagreement	Usually minimised	Incorporated into scoring	Used as a learning opportunity
Feedback	Correct/incorrect with explanation	Concordance-based score	Expert responses, justifications and synthesis
Learner focus	"What is the correct answer?"	"How closely does my judgement align with experts?"	"Why did experts reach these decisions, and how should this modify my reasoning?"
Potential orthopaedic application	Core knowledge and established management principles	Assessment of reasoning in uncertain orthopaedic scenarios	Teaching nuanced clinical and operative decision-making

Why Orthopaedics Is Well Suited to Learning by Concordance

In orthopaedic decision-making there are many occasions when high quality evidence sets limits to what is safe practice, but does not necessarily dictate a single management choice that is universally applicable. The preferred treatment may be altered by fracture morphology, bone quality, age, functional demand, soft-tissue status, comorbidities, availability of implants, rehabilitation potential and patient preference.

Surgical education is a bit more complicated. Knowing what operation can be done is not the same as deciding whether to do it, when to do it and on

whom to do it. Studies of surgical SCT have demonstrated that concordance-based methods can discriminate between levels of clinical reasoning among trainees [8-10]. Recently, SCT has been used by Soelling et al. to explore the especially tough surgical judgement of operating. Concordance-based assessment was more relevant to preoperative decision making [11], as indicated by higher scores in senior surgical residents compared to junior residents.

Most relevant to orthopaedic education, Zhou et al. recently evaluated a multimodal framework of SCT combined with high-fidelity simulation in orthopaedic residents. Participants Thirty residents and 12 board-certified expert surgeons. Clinical scenarios Acute hip fracture, degenerative spine disease, and knee osteoarthritis. Experts were significantly better than residents on SCT, and postgraduate year-2 residents were better than postgraduate year-1 residents. SCT performance also correlated with various simulation performance measures [12].

This provides direct evidence that concordance-based assessment can discriminate clinical reasoning within orthopaedic training [12]. It has yet to show that LbC is an effective orthopaedic teaching intervention. But it does provide a logical starting point for investigating whether the reasoning captured by SCT can then be converted into learning by means of expert explanations, comparison and reflection.

From the Expert's Answer to the Expert's Reasoning

The value of LbC for education is not to show the trainees what experienced surgeons choose, but to show them what they are thinking about in choosing it.

Now imagine a 68 year old active patient with a 3-part displaced proximal humerus fracture with moderate comminution and good bone quality. One experienced surgeon may favour fixation due to functional demand and reconstructibility. Others may prefer arthroplasty because of concerns regarding vascularity, tuberosity healing or fixation failure. A third may feel that depending on the degree of displacement, patient expectations and comorbidity, non-operative management is appropriate.

Showing only these 3 options does not teach much. By asking each surgeon to explain the variables that informed the decision, the cognitive architecture underpinning expert judgement is revealed to the learner.

Next, the learner may ask a more sophisticated question: not “Which surgeon is right?” but "What clinical variables would support each decision?

Such a change is particularly applicable to postgraduate training. Expertise is not about doing things differently without restriction. Rather it is a matter of knowing when the evidence clearly points to one course of action and when contextual uncertainty leaves room for several reasonable alternatives. Therefore, LbC may assist the trainees in differentiating legitimate clinical variation from unsafe deviation from established standards.

A Proposed Orthopaedic Learning-by-Concordance Model

A LbC exercise for orthopaedics could look like this:

Real case → Decision commitment → Justification → Expert panel replies → Expert reasoning → Comparison and reflection → Reapplication

The first case should have enough uncertainty to generate real reasoning. Disagreement in such cases may reflect knowledge deficiency rather than true clinical uncertainty [1,3]. Therefore, cases with a clear answer or established mandatory management are less appropriate.

For each scenario an independent answer will be given by a panel of experienced orthopaedic surgeons with brief reasons for their decisions. First, the learner makes a commitment to an answer before seeing the panel. This commitment is important because passive exposure to expert opinion does not require the learner to activate and test a clinical script.

Table 2 shows examples of potential applications across orthopaedic postgraduate training.

Table 2. Proposed applications of Learning by Concordance in orthopaedic postgraduate education

Orthopaedic domain	**Example uncertain scenario**	**Learner decision**	**Expert reasoning that could be exposed**	**Intended learning**
Trauma	Displaced proximal humeral fracture in	Non-operative treatment vs	Age, bone quality, fracture morphology,	Integrating patient and fracture

	an active older adult	fixation vs arthroplasty	vascularity, functional demand and reconstructibility	factors rather than relying on age alone
Sports medicine	Revision ACL reconstruction with tunnel widening and associated meniscal deficiency	Single-stage vs staged revision	Tunnel position and diameter, graft choice, bone stock, meniscal status and stability objectives	Understanding how interacting anatomical factors alter surgical strategy
Arthroplasty	Active patient with knee osteoarthritis, deformity and ligament imbalance	Continued preservation strategy vs arthroplasty and choice of reconstruction	Symptoms, deformity, ligament competence, activity expectations and implant strategy	Moving from radiographic diagnosis to individualised operative planning
Spine	Degenerative lumbar pathology with discordant clinical and imaging findings	Continue conservative care vs intervention	Neurology, symptom-imaging correlation, functional limitation and natural history	Avoiding decisions based on imaging alone
Postoperative care	Early postoperative wound drainage following joint replacement	Observation vs investigation vs return to theatre	Duration, wound characteristics, infection risk, systemic findings and implant consequences	Risk-based escalation under incomplete information
EPA/entrustment*	Resident performs a procedure safely but requires intermittent prompting at critical steps	Degree of supervision for the next comparable case	Technical performance, judgement, consistency, case complexity, risk and response to assistance	Making the reasoning behind entrustment decisions explicit

*The EPA/entrustment application represents a proposed extension of LbC and should be evaluated prospectively before conclusions regarding faculty calibration or inter-rater reliability are made.

II. BEYOND RESIDENTS

A Potential Role in Entrustment Decisions

The same concept might be relevant beyond resident clinical reasoning. Increasingly faculty in competency-based medical education must make judgements about the level of supervision a trainee needs. Such entrustment decisions are contextual and involve competence, case complexity, patient safety and supervisor tolerance of risk.

Faculty ratings variation is frequently treated as a simple assessment problem. However there is likely to be some variation as experienced faculty are going to weigh the information available differently. Making these reasoning processes explicit may possibly be a useful faculty-development exercise.

For example, faculty could independently review an EPA-based vignette of a resident's performance, assign an entrustment level, and state the reasons for that judgement. They could then compare their decisions and reasoning to those of a reference panel. The goal would not be to impose the same ratings, but to understand why ratings differ and which cues of performance should legitimately affect decisions during supervision.

Interestingly, recent surgical SCT research on preoperative decision making explicitly incorporated Entrustable Professional Activities into its educational context [11]. However, the use of LbC specifically for faculty calibration of EPA-based entrustment decisions is a proposed application. At the present time there is insufficient evidence to suggest that such an intervention would result in an increase in inter-rater agreement, assessment validity or subsequent supervisory behaviour. These questions provide a venue for future research.

III. CHALLENGES AND RESEARCH PRIORITIES

The inclusion of LbC in orthopaedic education would need to be carefully designed. Expert panels

should demonstrate credible clinical expertise, without implying that the majority opinion is necessarily best practice. Cases should not be questions poorly worded, but real uncertainty. Expert explanations should address the clinical variables that drive decisions, not just defend personal preference.

There is also the danger that concordance might be seen as an encouragement to conformity. Rather, the educational goal should be reasoned concordance, recognising the way experienced clinicians interpret available information, while preserving the learner's responsibility to critically evaluate evidence and justify decisions.

Current evidence also needs to be interpreted with caution. The recent scoping review showed increasing interest in LbC, but substantial heterogeneity in intervention design and evaluation [4]. Although SCT has been studied in surgical residents and now specifically in orthopaedic residents [8–12], this evidence cannot be automatically extrapolated to conclude that LbC improves orthopaedic clinical performance.

Future studies should therefore investigate whether orthopaedic LbC improves reasoning quality, transfer of learning to new clinical situations, decision confidence and workplace performance. Comparative studies may compare LbC with traditional case discussions or interactive seminars. Longitudinal studies could assess whether repeated exposure to expert reasoning accelerates the development of clinical scripts across levels of postgraduate training. Future research could explore whether faculty development based on LbC affects the consistency or quality of EPA entrustment decisions.

IV. CONCLUSION

Orthopaedic education must contain certainty and uncertainty. There are some clinical situations where the answers are established and trainees need to know them. Others require the surgeon to integrate evidence, anatomy, patient factors, risk and experience when selecting among a number of reasonable alternatives.Learning by Concordance might be a useful bridge between these two educational realities. Going beyond the expert's answer to reveal the expert's reasoning may help orthopaedic trainees understand not just what experienced surgeons decide but why they decide it.The goal is not to train trainees to agree with their instructors all the time. It's about preparing surgeons so that they are able to recognise uncertainty, weigh conflicting information and make decisions that are safe, evidence based and clinically defensible.

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