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The Development of Pattern Recognition via Clinical Experience: A Preliminary Study

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ABSTRACT

Introduction: Pattern recognition is a process whereby illness scripts are rapidly retrieved in response to attempting to recognize a clinical problem at hand. Although adeptness in clinical reasoning is not strictly related to years of clinical experience, pattern recognition as a part of such reasoning does require prior clinical experience if a repertoire of illness scripts is to be built up. Clinical experience provides the clinician with opportunities to link subjective description to objective findings and thus to appreciate the significance of changes in subjective findings. **Objective:** To investigate how pattern recognition develops through clinical experience. **Method:** 31 participants (10 undergraduate students and 21 clinicians) were surveyed via three rounds of questionnaires designed according to the Delphi technique to elucidate treatments for osteoarthritis of the knee and for Colles fracture after surgery. Consensus was considered achieved if 75% of the responses agreed. **Result:** For treatment of osteoarthritis of the knee, 72 items proposed by the students converged to 20 items, and 129 items proposed by the clinicians converged to 41. For postoperative care of Colles fracture, 41 items proposed by the students were reduced to 19 items while the clinicians honed 88 items down to 35 through three rounds of survey. **Conclusion:** The quasi-Delphi did enable both students and clinicians to achieve consensus. Whereas the students came up with relatively vague items, the clinicians described concrete problems that patients encounter. Such differences suggest instances of narrative and diagnostic reasoning that might be incorporated into physical therapy education.

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Introduction

An experienced clinician, when examining a patient, typically uses "illness scripts" in conceptualizing the patient's problem. An illness script is a specific conception in the mind of the clinician to be matched against basic information about the patient, the patient's complaints, pathophysiological signs and symptoms, factors contributing to the illness, and family history (1). When an illness script matches the empirical situation at hand, the patient's problem can often be quickly recognized and action efficiently taken. Illness scripts progressively accumulate in the mind of a clinician through clinical experience (2). The clinician eventually becomes able, when exposed to a given clinical picture, to automatically recall a relevant illness script to

initiate a focused inquiry in order to corroborate or refute a specific clinical hypothesis (3).

Pattern recognition is a process whereby illness scripts are rapidly retrieved in response to attempting to recognize a clinical problem at hand (4). This process requires the clinician to have built up a repertoire of illness scripts. It is a non-analytic form of reasoning, usually unconscious, whereby salient clinical features observed are recognized as similar to a specific previous experience (5). Patterns recognized involve syndromes, interventions, and pathobiological and psychosocial factors (6). Pattern recognition clearly excels over deliberative deductive reasoning in efficiently arriving at correct diagnoses (4). Although adeptness in clinical reasoning is not strictly related to years of clinical experience, pattern recognition as a part of such reasoning does require prior clinical experience if a repertoire of illness scripts is to be built up. Among other things, clinical experience provides the clinician with opportunities to link subjective description to objective findings and thus to appreciate the significance of changes in subjective findings. Therefore we hypothesised that subjective findings of pattern recognition in clinicians develop via clinical experience and the aspects of objective findings would be influenced by the subjective findings. The purpose of this study was to learn more about how physiotherapists acquire pattern recognition skills through clinical experience.

With the *Delphi method*, opinions and observations of members in a group are made to converge into a sophisticated consensus through an iterative use of questionnaires (7). The Delphi technique has four noteworthy characteristics: anonymity, sequential questionnaires, feedback, and distribution of answers to the group (8). This method has been used to achieve consensus in academic areas, social problems, education, medicine, and various other fields.

Clinical application of the Delphi technique can be found in the musculoskeletal area (9-14). Such studies achieved consensus after three to four rounds of questionnaires.

In a qualitative study, veteran physiotherapists frequently made decisions based on past professional experience, a resource unavailable to young physiotherapists, who had to depend more on reflection before acting (15). In a comparison between medical students and physicians, diagnostic accuracy was found to be related to clinical experience (16). In an examination designed to test skill in pattern recognition, senior surgical residents performed better than did medical students (17). These studies suggest that clinical experience may be necessary, if not sufficient, to develop pattern recognition of patients' problems. To what extent can pattern recognition be inculcated in novices? One way to approach this question would be to examine how an iterative approach such as the Delphi method yields a different kind of consensus in novices than in experienced clinicians.

Method

This study was approved by ethics committee of Hyogo University of Health Sciences. Three rounds of a quasi-Delphi technique were conducted to foster convergence in both the clinician and the student groups. The first round consisted of soliciting items to consider regarding osteoarthritis of the knee (OAK) and postoperative care of Colle's fracture (CFP), both conditions seen frequently in Japanese clinics and hospitals. Only items based on the disorders themselves were recorded. They were classified into subjective items, objective items and contributing factors, and then edited to fit into a questionnaire to be used in the second and third rounds. For each item, a five-degree Likert scale of (i) strongly disagree, (ii) disagree, (iii) undecided, (iv) agree and (v) strongly agree was used, and a tally of responses to that item in the previous round was displayed with the item. To avoid extraneous effects during the period of the three rounds, the participants were instructed to not discuss or study any topics related to the questionnaire.

Consensus on an item was deemed to have been achieved when more than 75% of the participants in a group indicated "agree" or "strongly agree"

in the third round. Percent agreement was calculated for each item by numerically weighting the responses (strongly disagree = 1, disagree = 2, undecided = 3, agree = 4, and strongly agree = 5) and dividing the sum of the weighted responses of "agree" and "strongly agree" by the sum of all the weighted responses.

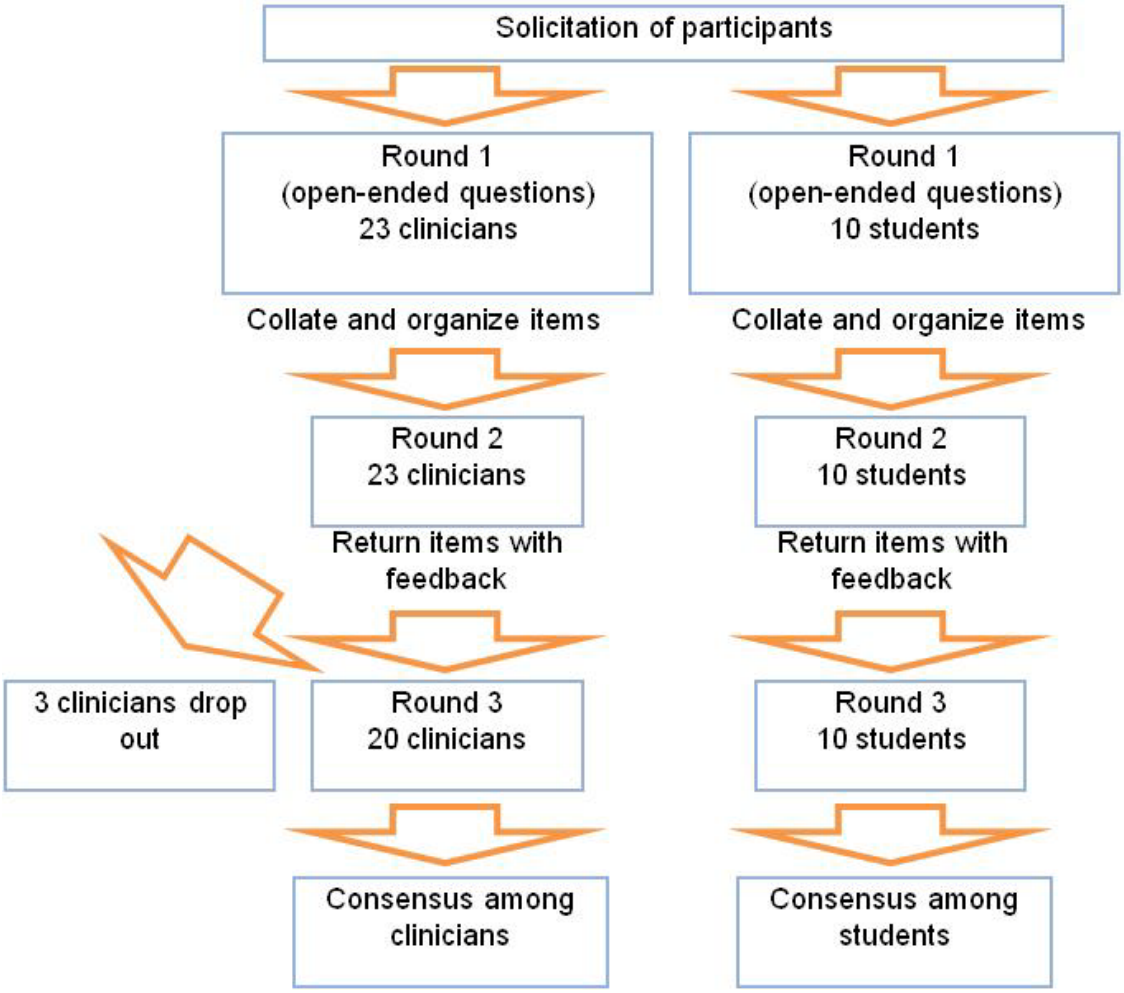

Figure 1: Iterative process of three sequential surveys.

Result

Three clinicians dropped out of the final round, so the response rate for the questionnaire was 100% for the students and 87% for the clinicians. In the first round, the students generated 72 items for OAK and 41 items for CFP, while the clinicians came up with 129 items for OAK and 88 items for CFP. After the third round, the students achieved consensus on 20 items for OAK and 19 items for CFP, while the clinicians reached consensus on 40 items for OAK and 35 for CFP (Figure 2).

The students reached consensus on six of their subjective items for OAK and on seven subjective items for CFP. The clinicians achieved agreement on 14 of their subjective items for OAK and on 14 for CFP. Among their objective items, the students had consensus on 11 items for OAK and on nine for CFP. The clinicians reached consensus on 21 and 18 of their objective items for OAK and CFP, respectively. As far as contributing factors are concerned, the students agreed on three items for OAK and on one for CFP, and the clinicians on five items for OAK and on three for CFP.

For OAK, the clinicians identified and agreed on many items related to various pathologies whereas the students limited themselves more to functional difficulties (Table 1). For CFP, the students tended toward kinesiological descriptions in their items and their subjective findings were expressed in relatively colloquial terms (Table 2).

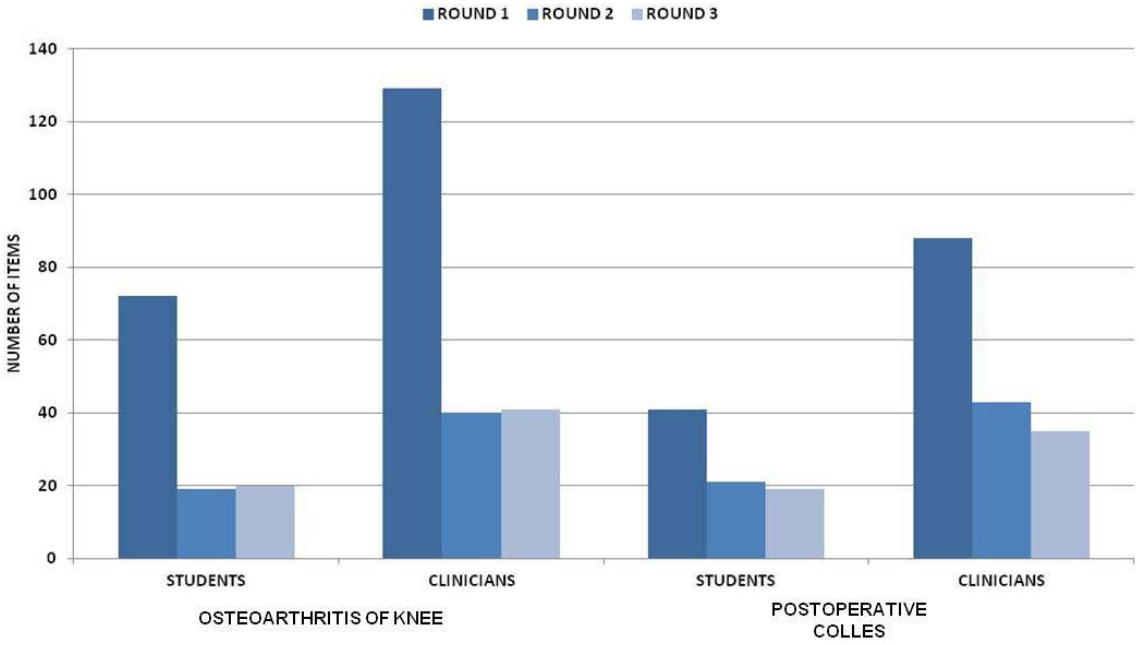

Figure 2: Convergence of items over three successive rounds. Round 1 was solicitation of items relevant to osteoarthritis of the knee or postoperative care of Colles fracture. Rounds 2 and 3 indicate number of items for which 75% agreement was achieved.

Table 1: Items of osteoarthritis of the knee identified by clinicians and by students.
(VMO: vastus medialis obliquus, ITB: iliotibial band, FTA: femorotibial angle)

Clinicians

Subjective items

		Round 2		Round 3	
		Composite score	% of consensus	Composite score	% of consensus
Onset of Symptom	Spontaneous onset	83	69.88	75	81.33
Area of Pain	Medial aspect of knee	96	94.79	83	100
	Anterior aspect of knee	84	69.05	76	80.26
	Posterior aspect of knee	86	80.23	75	80
Aggravating factors	Going up stairs	102	100	85	100
	Walking on slope	93	87.1	80	100
	Sit-to-stand/ sit down	98	96.94	84	100
	Initiating gait	100	100	81	92.59
	Weight bearing	98	97.96	85	96.47
	Full squatting	92	80.43	79	93.67
Activity restrictions	Cannot sit on heels	100	97	80	92.5
	Difficulty to do full squat	99	96.97	83	92.77

Students

	Round 2		Round 3	
	Composite score	% of consensus	Composite score	% of consensus
Knee movements	44	93.18	46	100
Initiation of movement	41	92.68	42	92.86
Gait	41	92.68	44	93.18
Weight bearing	43	93.02	43	93.02
Difficulty to straighten knee	41	85.37	41	92.68
Claudication	41	87.8	40	87.5

Objective items

		Round 2		Round 3	
		Composite score	% of consensus	Composite score	% of consensus
Swelling	Swollen knee	95	93.68	77	84.42
Muscle atrophy	Vastas medialis	100	97	87	100
	Thigh and lower leg	90	87.78	81	96.3
Joint deformity	Varus deformity of knee	99	96.97	84	96.43
	Valgus deformity of knee	92	86.96	78	80.77
Gait	Lateral thrust	97	93.81	83	96.39
Tenderness	Over tibiofemoral joint space	99	93.94	81	88.89
Muscle tightness	Vastus lateralis	91	90.11	77	84.42
	Iliotibial band	94	93.62	78	84.62
Hydrarthrosis	Positive findings of Ballottement test	92	81.52	77	84.42
Restriction of the raange of motion	Tibiofemoral joint flexion restriction	100	100	83	100
	Tibiofemoral joint extension restriction	101	100	83	92.77
	Patellofemoral joint restriction	95	93.68	79	88.61
Muscle strength	Weakness of quadriceps	90	80	78	84.62
Images	Osteophyte in radiograph	99	100	83	100
	Osteosclerosis in X-ray	98	96.94	83	100
	Irregular articular surface	90	83.33	79	92.41
	Knee joint space narrowing in X-ray	98	100	84	100
	Medial knee joint space narrowing	97	100	84	100
	Varus deformity of knee in X-ray	94	93.62	78	88.46
	Increased/ decreased FTA angle	94	90.43	79	88.61

	Round 2		Round 3	
	Composite score	% of consensus	Composite score	% of consensus
Swollen knee	42	92.86	41	92.68
Varus deformity of knee	44	93.18	43	93.02
Lateral thrust	42	85.71	43	86.05
Difference of weight bearing between affected and unaffected sides during gait	38	76.32	42	85.71
Positive findings of Ballottement test	39	76.92	39	84.62
Restricted range of knee extension	47	100	42	100
Weakness of quadriceps	39	92.31	38	84.21
Cartilage erosion	47	100	47	100
Knee joint space narrowing	47	100	48	100
Osteophyte in radiograph	44	93.18	44	93.18
Increased/ decreased FTA angle	42	92.86	43	100

Contributing factors

		Round 2		Round 3	
		Composite score	% of consensus	Composite score	% of consensus
Age	Over 50 years old	85	72.94	77	85.71
Gender					
Obesity		96	96.88	82	96.34
Muscle weakness	Trunk and lower extremity	89	86.52	76	84.21
	Gluteus maximus	88	79.55	77	84.42
	Gluteus medius	88	82.95	77	88.31

	Round 2		Round 3	
	Composite score	% of consensus	Composite score	% of consensus
Over 40 years old	42	78.57	43	93.02
Female	45	100	45	100
	45	100	46	100

Table 2: The Findings in post surgery of Colle's fracture in student and clinician groups

		Clinicians				Students			
Onset of history		Round 2		Round 3		Round 2		Round 3	
		Composite score	% of consensus	Composite score	% of consensus	Composite score	% of consensus	Composite score	% of consensus
Cause of injury	Breaking fall with hand	99	94.95	86	100	49	100	49	100
Subjective items									
Area of pain	Distal head of radius in acute stage	99	97.98	83	96.39	Pain in wrist	44	95.45	46	93.48
	Around wrist	98	96.94	81	96.3					
	Dorsal aspect of wrist	92	90.22	81	96.3					
Area of effusion	Distal forearm	90	87.78	78	88.46					
	Around distal radial head	92	90.22	76	84.21					
Resting pain						Wrist	41	87.8	43	93.02
						Forearm	41	92.68	41	92.68
Aggravcating factors	Moving wrist	96	100	82	100	Moving wrist	46	100	46	93.48
	Turning hand over (pronation/supination)	95	100	81	96.3	Moving forearm	43	100	43	93.02
	Placing hand on a flat surface	96	100	85	100	Dorsiflexion of wrist	45	93.33	45	100
	Carrying a heavy object	93	93.55	80	96.25					
Feeling of Weakness	Around wrist	94	93.62	76	84.21					
	Grip power	98	93.88	82	96.34					
	Pinch strength	92	83.7	78	88.46					
The other	Difficult to move wrist	94	96.81	79	96.2	Restricted active wrist range	46	100	46	100
	Oedema around distal radial head	92	90.22	76	84.21					
Objective items									
		Round 2		Round 3			Round 2		Round 3	
		Composite score	% of consensus	Composite score	% of consensus		Composite score	% of consensus	Composite score	% of consensus
Swelling	Distal radius in acute stage	100	100	82	96.34	Distal forearm	41	92.68	43	93.02
	Forearm to fingers	90	83.33	76	80.26	Wrist	43	95.35	46	100
Heat	Distal radius in acute stage	96	94.79	81	92.59	Wrist	43	95.35	43	86.05
						Forearm	40	85	42	85.71
Palpation	Bony tenderness	94	87.23	81	96.3	Muscle tightness after cast treatment	42	78.57	40	87.5
	Malalignment of carpal bones	89	83.15	79	88.61					
	Change in movement axis of wrist and forearm movements	86	75.58	76	84.21					
Restrictiono of the range of motion	Active range of wrist (dorsal and volar flexion) and forearm (pronation and supination)	93	96.77	83	96.39	Dorsal/ volar flexion	46	100	45	100
	Volar flexion	98	100	81	96.3	Wrist movement	41	92.68	40	85
	Dorsiflexion	93	91.4	77	90.91	Contracture from long use of cast	43	86.05	43	100
	Ulnar deviation	90	87.78	75	80					
	Supination	94	96.81	79	92.41					
	Pronation	91	93.41	76	84.21					
	Accessory movement	91	90.11	77	88.31					
Muscle strength	Weakness of hand and wrist	95	93.68	82	96.34	Decreased grip strength	41	85.37	39	84.62
	Intrinsic muscle weakness of hand and fingers	85	76.47	76	84.21					
	Decreased grip strength	96	100	83	100					
Images	Fracture line on distal radius in X-ray	101	97.03	85	100					
	Dinner-fork deformity in X-ray	97	93.81	84	100					
Contributing factors										
		Round 2		Round 3			Round 2		Round 3	
		Composite score	% of consensus	Composite score	% of consensus		Composite score	% of consensus	Composite score	% of consensus
	Osteoporosis	97	90.72	84	92.86	Osteoporosis	43	86.05	42	85.71
	Elderly	93	90.32	80	88.75					
Comorbidity										
		Round 2		Round 3			Round 2		Round 3	
		Composite score	% of consensus	Composite score	% of consensus		Composite score	% of consensus	Composite score	% of consensus
						Peripheral nerve injury	40	92.5	40	85

Discussion

In this study, we attempted to find out an effect of clinical experience by using a Delphi method with both experienced and inexperienced people. Consensus concerning pattern recognition was achieved in both groups over three rounds of query. The students invariably produced fewer findings for pattern recognition than did the experienced clinicians. The reason why the fourth-year undergraduate students were chosen as control group was because they acquired the standard knowledge with less clinical experience as physiotherapists.

The clinicians' items concerning subjective findings described patients' complaints more specifically than did corresponding items generated by the students. This likely reflects experience that informed the clinicians of troubles that patients typically face in their daily lives. Certain movements appear to have been recognized among the clinicians as common problems; using narrative reasoning, they would interpret these movements in terms of how patients perceived their own disorders (19). Narrative reasoning has been observed to be a feature in the interview process of experts (20). For patients with OAK, the clinicians suggested looking for pain in specific situations such as ascent or descent of stairs, whereas the students queried about pain in more general circumstances of motion, as during gait. For CFP, clinicians included feeling of weakness in hand grip and difficulty of placing the hand onto a flat surface. The students, for their part, tended to describe subjective findings in terms of joint motions and positions, such as "pain during dorsiflexion of the affected wrist". Clinical experts can use specific chunks of information that they associate with a given clinical condition to infer the possibility of concrete problems (3). One reason for the students generating fewer items on pain might be attributable to their inexperience with actual signs and symptoms, requiring them to resort to consciously associating textbook knowledge with what little they have seen in the clinic (21).

For objective findings in OAK, the students limited themselves to tibiofemoral joint problems and came up with descriptions similar to their subjective findings. The clinicians included patellofemoral difficulties along with tibiofemoral joint problems as well as radiographic findings in OAK. Both groups indicated weakness of the quadriceps as important to consider. Functional aspects of the knee have been found to merit attention more than image findings in OAK (22). Various objective findings put forth by the clinicians address this problem.

Whereas the clinicians specified a number of passive physiological movements for examining CFP patients, the students came up with relatively few objective examinations, likely a consequence of their lack of clinical experience. The main difference of subjective findings between students and clinicians may likewise have resulted from the disparity of experience in interviewing patients. Students would likely have difficulty eliciting information from patients via narrative reasoning. Most of the items generated for CFP by the students related to restricted range of movement, perhaps because of the period of cast immobilization of the wrist that one would expect. The students would thus focus on the secondary effects of wrist immobilization rather than features of CFP itself. Clinicians might be able to reassess functional movements which were elicited throughout interviewing since they can predict how the symptom interrupts the typical movements.

Both groups appeared to have assumed CFP patients to be older than what one might expect from epidemiologic studies. The age of CFP patients is typically about 30 to 60 years old (23). In one study, mean age of distal radial fracture was approximately 23 years for men and 48 years for women (24). Another article mentioned over 50 years old as prevalent for CFP, with a close relationship between osteoporosis and CFP (25).

Some of the clinician's items for OAK reflected the Japanese custom of sitting cross-legged on the floor. Sitting on the heels (*seiza*) was

included in a subjective item. Medial knee pain and varus deformity in OAK were included by the clinicians in spite of a likelihood of complaining of pain over either medial or lateral aspects of the knee. People sitting on the floor as part of Japanese lifestyle might account for choice of these items.

This study aimed to clarify how clinical experience with patients influences pattern recognition. The object of this study was not to look into clinical features of specific musculoskeletal disorders. We hypothesized that (i) appreciation of subjective symptoms would change through clinical experience with patients and (ii) attention to objective aspects was influenced by the degree of appreciation of subjective symptoms. The results of this study accords with these hypotheses. Our findings suggest that students find it difficult to imagine specifically how patients are troubled, and that pattern recognition develops as a professional craft is updated via clinical experience. Clinical experience with patients is essential to promote illness scripts (21). This study corroborated the idea of development of illness scripts via clinical experience with real patients. The number of participants in Delphi studies varies, ranging by one account from 10 to more than 1500 people (26), yet this number is related to neither statistical sample size nor validity (10). The number of participants in this preliminary study fulfilled the minimum requirement specified in previous studies.

This study is limited in that we did not assess ability of pattern recognition among the physiotherapists or their degrees of experience in treating OAK or CFP. Although the findings of this study may pertain to pattern recognition of musculoskeletal disorders for physiotherapists, applicability to other clinical areas such as neurological or cardiovascular problems may merit separate study.

Conclusion

The necessity of clinical experience in developing illness descriptions of two musculoskeletal disorders was confirmed through use of a quasi-Delphi technique in comparing students with very limited clinical experience against seasoned clinicians. In portraying subjective aspects of the clinical conditions, the clinicians resorted more to colloquial descriptions than did the students. Our findings suggest that students find it difficult to imagine specifically how patients are troubled, and that pattern recognition develops as a professional craft is updated via clinical experience.

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