



Original Research

The Concerns and Experiences of Patients With Lumbar Spinal Stenosis Regarding Prehabilitation and Recovery After Spine Surgery: A Qualitative Study



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KEYWORDS

Back pain;
Low back pain;

Abstract *Objectives:* To improve our understanding of patients' perspectives regarding: (1) the decision-making and prehabilitation before lumbar spinal stenosis (LSS) surgery and (2) their postoperative experiences.

List of abbreviations: LSS, lumbar spinal stenosis; RCT, randomized controlled trial

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Physical therapy modalities;
Preoperative exercise;
Qualitative research;
Rehabilitation;
Spinal stenosis

Design: Qualitative research with semi-structured interviews.

Setting: General community.

Participants: Individuals who received (N=10) and who did not receive (N=15) prehabilitation before LSS surgery were recruited at the 6-month postoperative follow-up (8 females; average age: 67.7±6.7 years) by purposive sampling. Additionally, 1 participant invited her daughter to accompany her in an interview.

Interventions: Not applicable.

Main Outcome Measures: Concerns and experiences of patients with LSS regarding prehabilitation and recovery after spine surgery.

Results: Thematic analysis was conducted to identify 4 themes inductively: (1) sources of information about LSS surgery; (2) factors affecting the surgical decision-making; (3) attitudes toward prehabilitation; and (4) postoperative recovery. All participants desired to have more preoperative education to inform their surgical decision-making. There were mixed opinions regarding the perceived benefits of prehabilitation because some individuals hesitated to participate in prehabilitation because of their symptoms, or the cost or time of traveling. Many participants expected some or even complete relief of LSS-related symptoms after surgery. However, not all participants experienced the expected postoperative improvements. Some participants only experienced temporary symptomatic relief, while others experienced new postoperative symptoms. Patients generally found that postoperative exercises taught by physiotherapists were useful although their compliance decreased over time.

Conclusions: Our study highlights the need for better preoperative LSS education. Because face-to-face prehabilitation or postoperative rehabilitation may not be feasible for all patients, future studies should explore whether online-based prehabilitation or postoperative rehabilitation may benefit certain patient subgroups.

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Lumbar spinal stenosis (LSS) is a prevalent degenerative spinal condition caused by the narrowing of the lumbar spinal canal.¹ Symptomatic LSS affects 20%-50% of people aged 70 years or older.² Many patients with LSS experience neurogenic claudication (eg, pain, paresthesia, weakness) radiating from the spine to the leg(s),^{1,3,4} which adversely affects their daily function and quality of life.^{2,3,5}

Patients with severe LSS who fail conservative treatments are indicated for spine surgery.⁶ LSS is the most common reason for patients aged above 65 years to undergo spine surgery.³ Given the growing number of LSS-related surgeries,^{7,8} LSS imposes a huge burden on the health care system.⁷ Unfortunately, the success rate of LSS surgery is approximately 60%,^{9,10} and the long-term (eg, 4 years) clinical benefits of LSS surgery remain inconclusive.¹¹⁻¹³

Because patients' suboptimal preoperative physical fitness may compromise their postoperative clinical outcomes, prehabilitation (preoperative physical training) has been proposed to optimize patients' preoperative physical fitness to minimize postoperative morbidities and facilitate postoperative recovery.¹⁴⁻²² Research found that patients with degenerative lumbar spinal disorders undergoing prehabilitation before lumbar surgery obtained significantly better postoperative symptoms and faster physical recovery than the usual care counterparts.^{16,17,23} A randomized controlled trial (RCT) revealed that a 6-week supervised prehabilitation program was significantly better than usual preoperative care in improving preoperative pain, self-reported disability, lumbar muscle strength/endurance, and functional performance of patients with LSS, although these differences were not

clinically significant.¹⁹ These beneficial effects also disappeared after surgery. However, the prehabilitation group demonstrated clinically significantly better Oswestry Disability Index scores than the usual care group at postoperative 6-month follow-up.¹⁹

While further studies are warranted to confirm the effectiveness of prehabilitation for these patients, it is paramount to understand patients' perspectives/experiences regarding prehabilitation through qualitative research if prehabilitation is going to be implemented systematically. Prior qualitative studies have investigated the life experience of patients with LSS, perceived factors affecting the self-management of LSS symptoms, and opinions regarding non-surgical LSS treatments or patients' preparation for LSS surgery.²⁴⁻²⁸ However, to our knowledge, no qualitative research has investigated their perspectives regarding structured prehabilitation and postoperative recovery. Therefore, this qualitative study aimed to understand patients' concerns/considerations before LSS surgery, their perspectives toward prehabilitation, and experiences after LSS surgery.

Methods

Semi-structured interviews were conducted between August 2020 and February 2021 to interview Chinese aged 50 years or older diagnosed with LSS 6 months after posterior open decompression surgery (eg, facetectomy/laminectomy, discectomy, or spinal fusion) in Hong Kong. Participants were recruited from individuals participating in a 2-arm RCT that aimed to compare the effectiveness of

a 6-week structured prehabilitation program and usual preoperative care on clinical outcomes of patients undergoing LSS surgery (ClinicalTrials.gov number: [NCT03388983](#)). Details of the prehabilitation program have been reported elsewhere.^{14,18,19} The program aimed to optimize trunk stability, and back and lower limb muscle strength and endurance. The usual preoperative care group received information from orthopedic surgeons and a leaflet regarding proper postures and physical activity. A research assistant invited those who had completed the 6-month postoperative follow-up to participate in semi-structured interviews. Each face-to-face interview involved a facilitator, the research assistant, and a patient.^{24,28,29} One participant requested her daughter to accompany her in the interview to provide supplementary information, if necessary.

After obtaining the participant's informed consent as suggested by the institutional review board, the facilitator (a physiotherapist with prior qualitative research experiences and not involving in the data collection or intervention of the RCT) conducted the interview at a venue chosen by the participant. The facilitator asked open-ended questions to all participants regarding the participant's preoperative symptoms and preparation, opinions or expectations about the structured prehabilitation program (thereafter referred as prehabilitation), and experiences after the spine surgery ([appendix 1](#)). Before the end of the 60-minute interview, participants were asked to clarify any points or add anything that had not been covered in the interview.²⁴ Each interview was audio-recorded.^{24,27,28} All interviews were transcribed verbatim with participants' names replaced by unique numbers.

A 6-step thematic analysis was conducted to understand participants' experiences, thoughts, or behaviors.³⁰ The thematic analysis included data familiarization, initial code generation, searches of potential themes, reviews of themes, defining and naming themes, and finalizing the report.³¹ Data analysis was conducted using NVivo 12 Plus.^a Two coders (A.L. and O.F.) independently reviewed a transcript to get preliminary ideas.³¹ Each coder proposed initial code names and definitions based on data emerging from the transcript.^{24,27,30,31} Both coders then discussed and created the initial codebook using an interpretive description approach.^{24,32} Using the initial codebook, both coders independently coded 5 transcripts and then juxtaposed the codes, resolved the discrepancies through discussion, and

revised the codebook. The coders subsequently used the revised codebook to code another 5 transcripts.

The generated codes were collated into potential themes. Relevant codes that demonstrated a coherent pattern and a clear distinction from other themes were combined to form a theme.^{30,31} The themes were reviewed at the level of the coded data extracts and the entire dataset.^{30,31} Each theme was continuously analyzed and refined to create a clear definition and a name.^{30,31} Participants' direct quotes were extracted from transcripts to illustrate key features of the themes and convey the common participants' views/themes.^{30,31} Recruitment ended when both coders agreed that data saturation was achieved in the prehabilitation and control groups without a new theme arising in the last 5 interviews.^{24,29} To report the selected direct quotes in English, a bi-directional process was conducted. One bilingual coder (A.L.) semantically translated the quotes to English, while an independent bilingual reviewer (A.W.) translated the quotes back to Chinese. The original and the back-translated quotes were then compared. Any discrepancy in meaning was resolved by consensus.

The intercoder reliability was estimated by kappa statistics after the first round of transcript coding.^{24,27} Kappa values range from -1 to 1, where 1 indicates a perfect agreement and 0 indicates a chance agreement.³³

Results

Twenty-five participants (9 females; average age: 67.7±6.7 years; average body mass index: 26.4±5.4) were recruited. Ten and 15 participants ([table 1](#)) were from the respective prehabilitation (n=15) and control (n=20) groups in the original RCT at the time of participant recruitment. The average preoperative Oswestry Disability Index score of these participants was 41.9±17.8%, indicating severe back pain-related disability.³⁴ Those who participated in the current study had similar demographic characteristics as those enrolled in the RCT.

Four themes were identified from the interviews: (1) sources of information about LSS surgery; (2) factors affecting surgical decision-making; (3) attitudes toward prehabilitation; and (4) postoperative recovery. The intercoder reliability of the thematic analysis was moderate (kappa=0.67).³³ Participants in both groups had very similar

Table 1 Demographic information of participants

Characteristics	Prehabilitation Group (n = 10)	Usual Preoperative Care Group (n = 15)
Women	3 (33.3%)	5 (33.3%)
Age (y)	66.4±4.4	66.5±8.0
Body mass index (kg/m ²)	27.1±2.8	28.0±5.9
Retirement	100%	100%
Marital status		
- Married	10	14
- Divorced	0	1
Preoperative Oswestry Disability Index (out of 100)	43.1 ± 14.2	42.6 ± 18.2

experiences or opinions regarding the 4 themes. However, only participants in the prehabilitation group had first-hand experiences of prehabilitation to influence their attitudes toward prehabilitation.

Theme 1: sources of information about LSS surgery

Although all participants obtained LSS-related information from orthopedic surgeons who explained the pathology of LSS, treatment options, coping strategies, or details of spine surgery, 24 participants desired more information regarding LSS and its management. Some patients in both groups expressed difficulty in finding relevant information before surgery because they only partly understood their condition after doctors' explanations. Related quotations are presented in [table 2](#). However, some participants in both groups perceived their orthopedic surgeons unwilling to provide detailed explanations because surgeons were busy or the consultation time was too short. One participant shared: *"Those doctors whom I met before seemed unwilling to talk to you. When you tried to ask questions, doctors didn't want to answer"* (P29).

To solicit more information regarding LSS surgery and/or potential postoperative sequelae, 16 participants (six and 10 from the prehabilitation and control groups, respectively) turned to family/friends. While family and friends might help participants better understand the surgery through discussion/explanation, the equivocal information/opinions might confuse participants. Some suggested alternative therapies might even harm participants.

In addition to family and friends, 14 participants (seven from each group) chose to search information online, while 1 learned general exercises on television. However, 5 participants did not know how to use the internet to search information. More relevant quotations are listed in [table 2](#).

Theme 2: factors affecting surgical decision-making

Orthopedic surgeons played an important role in influencing participants' (n=20) surgical decision-making. Surgeons emphasized the necessity of surgery in relieving patients' signs and symptoms. They also reassured patients regarding

Table 2 Supporting quotations for Theme 1 - Sources of information about lumbar spinal stenosis surgery

Information From Physicians

1. "He/she [Doctor] said that there was something stuck inside that compressed my central nervous system. I had to undergo the surgery to resolve it. The only way to relieve the symptoms was surgery" (P06, man, 73 y old).
2. "The doctor explained that my 2 levels [lumbar vertebrae], the fourth and fifth levels were compressing the nerves. The doctor would open it up and remove the irrelevant things to release them [the compressed nerves]. Then I would not feel pain" (P14, man, 69 y old).
3. "So, the doctor suggested me to change my lifestyle, "You can use a car to travel and walk less. You have already been so old. It is expected" (P19, man, 66 y old).

Insufficient Information

10. "I did not even know what the diagnosis was" (P06, man, 73 y old).
11. "I didn't know where to search for it (the relevant information). I couldn't understand it. . . . I did not know how to search for information or interpret the information. How could I know how to search for such information?" (P11, woman, 64 y old).
12. "I did not understand what the doctor said. I just listened to what he said" (P16, woman, 74 y old).
13. "I did not understand what was going to happen. It was because those doctors whom I met before seemed unwilling to talk to you. When you tried to ask some questions, doctors didn't want to answer. My doctor took a spine model and then showed it briefly to you. Those doctors were like that" (P19, man, 66 y old).
14. ". . . Around 4-5 minutes (consultation time). Not much explanation. . . Doctors had to see many people" (P21, man, 64 y old).
15. "It's ok. I have seen that doctors are very busy. I didn't want to . . . occupy them [doctors] for so long" (P24, woman, 62 y old).

Information From Family or Friends

4. "But for the surgery, there were so many negative opinions, and I was scared. I worried about the worst case. I might not be able to walk again. I might be paralyzed" (P01, man, 69 y old).
5. "Not really understood (after meeting the doctor). I could understand more after discussing with my friend(s)" (P05, man, 62 y old).
6. "I mentioned it to some close friends. Everyone had different information (opinions). It was quite confusing for me as a patient" (P05, man, 62 y old).
7. "I tried the "so-called" treatment suggested by my friend's friend for many times. I suffered from a burn injury in the last 2 times because he placed many burning dried mugwort directly on my back" (P05, man, 62 y old).

Information from other sources

8. "I usually asked people. I seldom use the internet" (P18, man, 66 y old).
9. "I do not have access to the internet. I do not know how to surf the internet. . . I am that old" (P17, man, 70 y old).

Table 3 Supporting quotations for the Theme 2 - factors affecting the surgical decision-making

Surgeon's Recommendation

1. "Eventually, the doctor told me that I had to undergo this surgery to relieve [the symptoms]. Given my condition, my first response was agreeing to have the surgery" (P10, man, 63 y old).
2. "Every doctor mentioned that it would not work. You could not benefit from physiotherapy. Your lumbar spine was misaligned. . . For this, . . . it should be fixed by screws in order to correct it" (P29, woman, 44 y old).
3. "The orthopedic surgeon also provided professional advice. He said that the risk of surgical complications was very low" (P14, man, 69 y old).

Relationships With Surgeons

4. "And I have strong confidence [in the doctor]. When I went to see a doctor, I fully trusted the doctor" (P12, man, 63 y old).
5. "I asked, 'How did you operate on my spine?' The doctor said, 'You come and see!'. The doctor then showed it me. Dr Cheung showed it [radiograph] to me during the follow-up. . . Yes, I felt very good" (P25, woman, 73 y old).
6. "I was afraid of the doctor. I was afraid that the doctor would think 'It is meaningless for me to treat you. I have already given the most powerful painkiller to you. If you do not undergo surgery, it is useless to come to see me'. Then I decided to undergo the surgery" (P18, man, 66 y old).
7. "Because. . . the professor was unhappy [after I refused the surgery]" (P24, woman, 62 y old).
8. "The main reasons are because of the Hong Kong medical system and doctors' techniques. Doctors would do it very well. The most important thing is the confidence. . . Since many people don't understand the medical system and the surgical techniques, they are afraid. However, we understand that because we have experience it. I underwent 2 surgeries before" (P10, man, 63 y old).

Disabling Symptoms or Unsuccessful Non-Surgical Treatments

9. "Even if the doctor declined the surgery, I still wanted to have it because it was so painful that I could only lay in bed. I couldn't even walk. Not to mention about getting up" (P10, man, 63 y old).
10. "I knew I had to have the surgery because physiotherapy had no effect" (P06, woman, 73 y old).
11. "I received around 10 sessions of physiotherapy but there was no improvement. That was a private clinic but there was no effect" (P03, woman, 70 y old).
12. "I initially thought that I could rely on acupuncture and some exercises (to recover). However, it did not work. These methods could not relieve my symptoms" (P06, man, 73 y old).

Family or Friends' Influences

13. "My sister also underwent the same surgery. She received her lumbar surgery 7-8 years ago. The outcome was good. I thought that it was not a big deal to undergo the surgery" (P04, woman, 64 y old).
14. "I discussed with my family when I went back [home]. And . . . they supported me to undergo the surgery" (P22, man, 63 y old).
15. "The eldest son said that I should have surgery. My 2 daughters said that it was too dangerous, and I shouldn't undergo the surgery" (P15, man, 79 y old).

Expectations of Surgical Outcomes

1. "I expected to fix the problem. I expected to be no problem after the surgery. When my nerve is no longer compressed, I would walk farther. That's it" (P20, man, 70 y old).
2. "Of course. . . I hoped that all the symptoms would be gone, right?!" (P22, man, 63 y old).

the low risk of surgical complications. One participant from the prehabilitation group said: "*Eventually, the doctor told me that I had to undergo this surgery to relieve [the symptoms]. Given my condition, my first response was agreeing to have the surgery*" (P10). Further, good patient-physician relations or consultation experiences facilitated the surgical decision-making. Quotations substantiating this theme are shown in table 3. Conversely, 2 participants (1 from each group) underwent LSS surgery partly because they did not want to upset their doctors (table 3).

Nineteen participants (8 from the prehabilitation group and 11 controls) opted for surgery because of disabling symptoms that affected daily functions. After they failed various non-surgical treatments, they desperately wanted to undergo surgery. Twenty-one participants (8 and 13 from

the prehabilitation and control groups, respectively) received conventional physiotherapy (not prehabilitation) before deciding to undergo LSS surgery, although 3 participants did not mention physiotherapy in their interviews. One participant underwent an emergency surgery because of sudden exacerbations of symptoms. Of those 21 participants receiving physiotherapy before their decision-making, 5 (two participants from prehabilitation and 3 controls) reported mild improvements after conventional physiotherapy, whereas 16 participants found no significant post-treatment effects.

Many participants (5 participants in the prehabilitation group and 8 controls) sought advice from families or friends to help surgical decision-making. Unfortunately, participants needed to deal with conflicting suggestions from family and

friends. P23 said: “The eldest son said that I should have surgery. My 2 daughters said that it was too dangerous, and I shouldn’t undergo the surgery,”

Despite uncertainty and worries, 15 participants (7 and 8 from the prehabilitation and control groups, respectively) underwent surgery because they expected that the surgery could help them greatly regain their mobility, prevent incontinence, or even completely relieve symptoms: “I hoped that all the symptoms would be gone, right?!” (P32). Eight participants expected that the surgery might slightly improve their symptoms. Two participants (1 from each group) were not sure whether they made the right decision. More related quotations are shown in table 3.

Theme 3: attitudes toward prehabilitation

Almost all participants in the prehabilitation (n=9 of 10) and control groups (n=13 of 15) participated in the prehabilitation trial because they wanted to contribute to academic research. Some participants deemed that prehabilitation allowed patients to perform exercises

under physiotherapists’ supervision (2 from the prehabilitation group and 4 controls), learn new things, or hasten their postoperative recovery (5 and 6 from the prehabilitation and control groups, respectively) (table 4). Some participants in the prehabilitation group joined prehabilitation because the clinic was easy to access (n=6) or they were free (n=5). Interestingly, 6 participants (3 from each group) expressed no expectation for prehabilitation. One participant in the prehabilitation group said: “Since I expected that I would recover only after the surgery, I didn’t expect any change (from prehabilitation) before the surgery” (P24).

Although prehabilitation might be beneficial, not all participants wanted to undergo prehabilitation. Seven out of 15 controls worried that they could not follow the exercise regimen or travel to the clinic because of severe LSS symptoms even if they were assigned to the prehabilitation group. Additionally, the cost and time of traveling to the clinic might deter them from participating in prehabilitation. Two of these 7 controls expressed that they would either quit the program or skipped some training sessions if they were assigned to the prehabilitation group.

Table 4 Supporting quotations for the Theme 3 - Attitudes toward prehabilitation

Positive Attitude Toward the Prehabilitation Trial

1. “Anyway, when a person gets older, he/she will have a lot of diseases. Therefore, I hope that you can come up with more research studies for seniors. That’s why. Therefore, I...when you asked me to sign [the consent form for participating in the research study], I was okay with that. The most important thing was that you could conduct more research studies... and I could help you more” (P17, man, 70 y old).
2. “Before the lot drawing, I hoped that I would be assigned to the exercise group. I thought that if I was assigned to the exercise group, I would be guided by professionals to do exercises” (P05, man, 62 y old).
3. “I hoped, would like to say, to have a faster recovery. . .Yes, before the surgery, I hoped that I would be stronger and more resilient (after the surgery), right?! faster recovery after the surgery” (P13, man, 71 y old).
4. “Before joining [the prehabilitation program], I couldn’t sit or stand. I followed the taught method to get up. I turned slowly. I followed the turning method instructed by the therapist. My symptoms at least were reduced. I could walk and took public transportation” (P10, man, 63 y old).
5. “Because they [physiotherapists] taught me some knowledge about how to protect my lower back, or other body parts, it was beneficial. For example, it helped me get in or out of bed. In the past, I got up immediately after I woke up. Now I understand that I should avoid certain movements. Otherwise, it may hurt some body parts or bony structures. After you have minimized those faulty movements, you would find it quite useful” (P08, man, 66 y old).

Negative Attitudes Toward the Prehabilitation Program

6. “I didn’t experience that [improvement in walking distance or muscle strength]” (P24, woman, 62 y old).
7. “Since I expected that I would recover only after the surgery, I didn’t expect any change (from prehabilitation) before the surgery” (P24, woman, 62 y old).

Barriers Associated With the Prehabilitation Program

8. “I have thought about it. I felt that it was better for me not to be assigned [to the intervention group]. Because I was in pain and didn’t know how to cope with various movements [prescribed exercises]. I had already been in pain, which affected my every step. However, if you still asked me to perform certain movements, how could I handle it? It was difficult for me to cope with the pain. I didn’t know . . . if I could cope with the exercises and physiotherapy. If I could not handle it, what was the point of being assigned [to the intervention group], wasn’t it? When she [a research assistant] told me that I was not assigned [to the intervention group], phew, I was so relieved and felt better than being assigned [to the intervention group]” (P11, woman, 64 y old).
9. “The first difficulty was [public] transportation. The second problem was the difficulty during traveling because I had already felt unwell” (P05, man, 62 y old).
10. “In fact, when she [a research assistant] first approached us, she [the participant] was quite reluctant to join the exercise therapy before surgery. Since we lived in Chai Wan and the traveling distance to Sandy Bay was long. That was why she said that she was not keen to do the exercises [prehabilitation]” (The daughter of P25, woman, 73 y old).

After prehabilitation, 7 participants in the prehabilitation group found that prehabilitation was beneficial (subjective improvements of lower limb muscle strength or functional mobility, reduced LSS-related symptoms, or learning new self-management skills). *“Because they [physiotherapists] taught me some knowledge about how to protect my lower back, or other body parts, it was beneficial”* (P08). However, 3 participants in the prehabilitation group reported no post-treatment clinical improvements. More relevant quotations are shown in [table 4](#).

Theme 4: postoperative recovery

Most participants (n=22) experienced some symptomatic relief and reduced analgesic intake after LSS surgery. Therefore, they had resumed their previous exercise habit or activities of daily living. However, 11 participants (4 in the prehabilitation group and 7 controls) experienced some undesirable surgical outcomes. Specifically, while some reported no subjective improvements in both groups, others reported new post-surgical symptoms, or recurrence and/or worsening of symptoms: *“At least 20% worse as compared to before. I know that it gets worse by 20% because I usually didn't feel any numbness at night in the past. . .no numbness after dinner. But now I feel the numbness”* (P28). More quotations related to postoperative outcomes are shown in [table 5](#).

Post-surgical therapeutic exercises were commonly prescribed by physiotherapists. Seventeen participants (7 in the prehabilitation group and 10 controls) deemed that therapeutic exercises helped them regain their postoperative lumbar range of motion, lower limb muscle strength, and walking ability. Twelve participants (6 in each group) reported that they continued those exercises because of the perceived benefits and availability of exercise equipment. However, 6 participants (2 in the prehabilitation group and 4 controls) stopped postoperative exercises because of poor exercise compliance, self-perceived full recovery, or no perceived benefits of exercises. More relevant quotations are presented in [table 5](#).

Because 10 participants (4 in the prehabilitation group and 6 controls) underwent surgery in late 2019, they found that the novel coronavirus outbreak severely affected their recovery given the closure of exercise facilities and discouragement of outdoor activities. P22 said: *“I can't go swimming. I have stopped hydrotherapy,”* Additionally, the concomitant comorbidities (eg, knee osteoarthritis) also hindered their rehabilitation.

Discussion

Our participants considered multiple factors before making surgical decision. Because most of them did not receive sufficient preoperative education, some had unrealistic expectations of postoperative improvements, resulting in disappointments. While many participants did not have much expectation of prehabilitation, they generally deemed that postoperative exercises were useful.

Most participants thought that they did not have enough knowledge about LSS and its management. This concurs with

prior studies that patients desired to obtain more useful information about LSS surgery preoperatively.^{24,27} Unfortunately, health care providers could not provide adequate preoperative education to patients because of time constraints or the use of medical jargons, which hinders doctor-patient communication or prevents patients from having realistic postoperative expectations.²⁴

Given the insufficient preoperative information from health care providers, all participants attempted to seek LSS-related information from families and/or friends to facilitate their surgical decision-making. This accorded with previous findings that patients made decision regarding elective orthopedic surgery based on information from the physician-in-charge, other health care providers, and family and friends.³⁵ Although other sources of information from multimedia, printed educational materials, and online resources have been reported to facilitate surgical decisions,³⁵ our participants seldom mentioned these sources. The discrepancy might be attributed to cultural differences, and/or poor literacy or health literacy. Some participants indicated that they did not know the medical term for LSS, which prevented them from searching relevant online information. In fact, not being adequately informed about a given health condition and poor health literacy are the common sources of stress for patients seeking medical care in public clinics in Hong Kong.³⁶ Therefore, orthopedists and physiotherapists should adopt multiple approaches (eg, pamphlets, videos, or talks) to improve preoperative education for patients with LSS. Prehabilitation could afford providers another opportunity to provide preoperative education to patients and to address their concerns during the treatment period as expressed by a participant in our prehabilitation group ([table 4](#)).

While face-to-face clinical contacts with physicians are the most common health education approach before elective surgery,³⁵ the provided information may be incomplete or biased by what the medical providers know or choose to inform patients.³⁵ Therefore, an algorithmic approach has been suggested to help manage LSS and to discuss treatment options with patients.³⁷ Such an approach could allow tailoring treatment pathway options based on clinical presentations to help clinicians select optimal treatments for patients with LSS.³⁸ Although such an approach may facilitate LSS management, patients engagement is crucial to their perceived health status and satisfaction.³⁶ Shared decision-making has been recommended to include patients, their caregivers, and medical providers in the process to achieve a collaborative patient-centered experience.³⁵ Specifically, shared decision-making requires clinicians to share the best available evidence regarding treatment options and explain each treatment in detail with patients in the process of clinical decision-making. Patients are encouraged to consider various options to attain informed preferences.^{39,40} Further, family should be involved in the process of informed consent and decision-making for any elective surgery.^{36,41}

Although previous research has suggested that prehabilitation may benefit patients before LSS surgery, as far as we know this is the first qualitative research to investigate patients' perspective on a structured prehabilitation program before LSS surgery. It revealed that the cost and time of transportation were barriers to participating in

Table 5 Supporting quotations for the Theme 4 – recovery after surgery

Surgical Outcomes – Positive

3. “Before the surgery, the numbness sensation extended from the waist to the leg, surpassing the lower leg. It has been completely gone after the surgery. . . There is no numbness after the surgery” (P05, man, 62 y old).
4. “At that moment, the private doctor prescribed analgesics for neuropathic pain for her. . . After the surgery there was no such problem. She has already thrown away all the medications” (The daughter of P25, woman, 73 y old).
5. “After the surgery, I can sit and walk now. I can walk for a maximum of almost 4 hours. I can do it without rest. That means, I don’t need to stop. I can do it continuously without any problem” (P10, man, 63 y old).

Surgical Outcomes – Negative

6. “At least 20% worse as compared to before. . . I know that it gets worse by 20% because I usually didn’t feel any numbness at night in the past. . . no numbness after dinner. But now I feel the numbness” (P18, man, 66 y old).
7. “It was fine for the initial few days following the surgery. There was no pain nor any symptoms. However, the pain returned on the following Saturday. Therefore, . . . it is constant pain. I have already been followed-up for the third times, the doctor said that he/she could not find out the reason for the recurrent pain. The doctor said that patients usually should have some improvements. . . for half a year. . . Therefore, it is pain again now. In fact, I have pain even in sitting. I still feel the numbness” (P18, man, 66 y old).

8. [Interviewer]: “For example after the surgery, did you experience any improvements?”

[S039]: “Sigh, not at all.”

[Interviewer]: “Didn’t you feel anything?”

[S039]: “Nothing”

[Interviewer]: “pain or other symptoms?”

[S039] “Err. . . not much”

[Interviewer]: “The same? The same numbness level as before?”

[S039]: “Yes”.

(P24, woman, 62 y old).

9. “I feel that there is more [symptoms]. In the past, I only had very mild dull pain. Now, there is numbness most of the time” (P04, woman, 64 y old).

Postoperative Rehabilitation

1. “In fact, exercises and various knowledge taught by physiotherapists are always useful. If you continue to do exercise and follow their suggestions and movements, it will somehow be beneficial. Yes, it is good (P22, man, 63 y old).
2. “It helped . . . more comfortable and less painful” (P15, man, 79 y old).
3. “Yes, since at that time the doctor in Queen Mary hospital referred me to physiotherapy once a week, I thought that the physiotherapy sessions would be finished soon. Therefore, I also signed up the District Council, Leisure and Cultural Services Department (LCSD) fitness classes. I did those exercises I learnt from the physiotherapy sessions” (P13, man, 71 y old).
4. “After the surgery, I held the pictures (instructions) to follow the suggested duration to raise up my leg. I did it. I even bought a yoga mat to do exercises. However, after 3 months, I stopped doing them. It’s like that you did 9 minutes first and then 7 minutes on the other day, and then gradually stopped doing exercises” (P08, man, 66 y old).

Barriers of Recovery after Surgery (eg, Outbreak of Pandemic)

5. “Now there is no hydrotherapy. I can’t go swimming. I have stopped hydrotherapy” (P14, man, 69 y old).
6. “I would like to say that since the pandemic, I have dared not to go out. . . dared not to. . . I reduced the frequency of doing exercises or swimming. As such, I stay at home all day. I feel pain and discomfort” (P13, man, 71 y old).

prehabilitation. Like many metropolitan areas, most people in Hong Kong take public transportation for daily commute.⁴² However, it is very challenging for patients with disabling LSS symptoms to use public transports commuting between homes and rehabilitation clinics. Prior research found that a home-based prehabilitation program was effective for promoting function before degenerative lumbar

surgery.¹⁶ This approach may suit patients with LSS who cannot travel to outpatient rehabilitation clinics.^{25,26} With the advancement of technology, telerehabilitation can provide cost-effective physiotherapy and patient monitoring at home.⁴³ Telerehabilitation can complement home-based rehabilitation by providing timely feedback to patients.⁴⁴ Future research is warranted to investigate the feasibility of

combining a home-based exercise program with telerehabilitation to improve preoperative function and postoperative recovery of patients with LSS. The finding may have strong clinical implications for situations (eg, pandemic) that require closure of exercise facilities, or social distancing, which is known to reduce physical activity in people with or without chronic diseases.⁴⁵

Three participants in the prehabilitation group did not perceive any subjective improvements after prehabilitation. Our result contradicted that of an RCT, which used an identical prehabilitation program and found significant preoperative improvements in pain and LSS-related disability in patients awaiting LSS surgery.¹⁹ The discrepancy may be because our participants had more severe disability as measured by the Oswestry Disability Index when compared with patients in prior research.^{18,19} Patients with more severe disability may benefit less from prehabilitation because their exercise intensity is limited by their symptoms. Further, participants' previous unfavorable outcomes after physiotherapy and/or the decision on undergoing LSS surgery might have placebo effects on prehabilitation. Future studies should identify patient subgroups that can benefit from center-based prehabilitation before LSS surgery.

Some participants were disappointed by negative surgical outcomes (eg, recurrence/maintenance of previous symptoms and/or new symptoms). Research has shown that perioperative complications (eg, spinal instability, infection, or neurologic damage) may occur in 10%-24% of LSS cases.^{13,46,47} Clinical benefits of LSS surgery are known to diminish over time,¹¹ with a 4-year reoperation rate of 13%.⁴⁷ If patients are not well informed of the potential short- or long-term adverse effects of LSS surgery (eg, adjacent segment diseases)⁴⁸ and the diminishing long-term benefits after LSS surgery, they may be disappointed. The disappointment will be even greater if there is a mismatch between patients' expectations of postoperative recovery and suboptimal postoperative clinical outcomes. Therefore, shared decision-making should be considered to improve patient decision-making and minimize potential conflicts.³⁶

Limitations

This study has several limitations. First, because our participants were enrolled from an RCT, their experiences might differ from those not involved in the trial. However, the similarity between our results and previous studies attests some common issues encountered by patients with LSS. Second, only 33% of the participants in each group were females, who tend to have a higher pain perception than males.⁴⁹⁻⁵¹ Therefore, our findings might have been slightly different had more females been recruited. That said, our results were comparable with a similar study investigating patients' perspective regarding unstructured prehabilitation before lumbar surgery.²⁴ Third, although our study did not recruit an equal number of participants from the prehabilitation and control groups, our findings were valid because both groups showed data saturation. Fourth, participants who participated in the interviews might differ from those who declined. However, this is an inherent limitation of qualitative research.^{26,52} Fifth, patients experiencing symptoms at the time of assessments

are more likely to recall previous pain episodes and/or exaggerate the recalled symptoms.⁵³ Therefore, participants with symptoms during interviews might perceive prehabilitation as ineffective. Sixth, because our interviews were conducted 6 months post-surgery, recall bias might have affected our findings. However, our average interview time was shorter than a similar qualitative study on prehabilitation (an average of 10 months post-surgery).²⁴ Our findings reflected the experiences of patients shortly after LSS surgery.

Conclusions

Patients undergoing LSS surgery strongly desired to obtain sufficient information from medical providers. Our findings highlight the importance of better informing patients in the decision-making process of elective surgery. While some participants wanted to join prehabilitation, disabling symptoms and difficulty in using public transportation hindered their participation. Future research should investigate the feasibility of using telerehabilitation to provide prehabilitation/postoperative rehabilitation to patients with LSS.

Suppliers

- a. NVivo 12 Plus; OSR International.

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Appendix 1. Interview guide

(The follow-up questions will be asked based on interviewer's discretion)

Pain experience

1. When you think about the last time you had low back or leg symptoms? Can you tell me how it feels like?
 - a. When was the last time you had it?
 - b. How long does it usually last before surgery or after surgery?
 - c. What were the activities that make the pain better? Or worse? (before and after surgery)
 - d. How would you describe the pain or symptoms (quality, location, constant, etc.)?
 - e. Several episodes, variation in duration, type of pain, ...?
 - f. What can you do to relieve the pain or discomfort?

Effects on daily life (before and after prehabilitation or before surgery)

2. Can you tell me your experience of back pain and how does it your life?
 - a. Did it stop you from doing certain activities?
 - b. How did your day look like if you didn't have back or leg discomfort?
 - c. How did your day look like if you had back or leg symptoms?
 - d. Did your symptoms affect your sleep? Going outdoor? Meeting friends?
3. How does living with lumbar spinal stenosis (LSS) feel like?
 - a. Yourself
 - i. Attitude toward life
 - ii. Dignity or perception of aging
 - iii. Acceptance
 - iv. Adaptation
 - v. Leisure time/activities
 - b. Your friends and family
 - i. Mood
 - ii. Burden
 - c. Your relationships with your health care providers
 - i. What type of provider? What is offered to you?
 - d. Do you talk about your back problem with family, or friends?
 - e. Can you describe your experience before and after the presence of your symptoms?
 - f. What did you usually do when you were in pain?
4. What bothers you the most about your LSS symptoms?
 - a. Was anything about your back worrisome?
 - b. How did you think your back problems would affect you in the future?

Representation of illness

5. What would be the possible causes of your back problem?
 - a. Any medical reasons?
 - b. Old age? Can you tell me more?
 - c. What is your knowledge about the illness?

Coping strategies

6. How do you manage your back pain before prehabilitation or surgery?
 - a. Any goals?
 - b. What kinds of treatments?
 - c. Any assistive devices?
 - d. Readings, attending lectures?
 - e. How do you take care of your problems?
 - f. Seeing physiotherapists?
7. Did those methods work?
 - i. If yes, how did they help?
 - ii. If not, why?
8. Why did you decide to have the spine surgery?
9. Did you discuss with someone before making up your mind to have the surgery?
10. Did you have any concerns or struggles after agreeing to undergo the surgery?

Perspectives regarding prehabilitation

11. Why did you determine to participate in the research project to evaluate the effects of prehabilitation for patients with LSS awaiting for spine surgery?

12. Do you think the prehabilitation help you or not?
 - i. If yes, how?
 - ii. If not, why?
13. Which factors would facilitate you to do prehabilitation (eg, convenience)?
14. What were the barriers to prehabilitation (eg, transportation, caregivers)?
15. How was your relationship with the therapist or research personnel?
16. Did the therapist or research personnel help you understand the reasons for your disease, surgery, or prehabilitation? Did they affect your decision to join or to stay in the program?

Effects on daily life (after surgery)

17. Can you tell me your experience after the surgery? how does it affect your life?
 - a. What kind of activities that you can do after the surgery? Sleep? Going out? Meeting friends?
 - b. How does your day look like after the surgery?
 - c. Are you happy with the results?
18. How does post-op living feel like?
 - a. Yourself
 - i. Attitude towards life
 - ii. Dignity or perception of aging
 - iii. Acceptance
 - iv. Adaptation
 - v. Leisure time/activities
 - b. Your friends and family
 - i. Mood
 - ii. Burden
 - c. Your relationships with your health care providers
 - i. What type of provider?
 - ii. What is offered to you?
19. What do you think about your future?
 - a. Is anything about your back or leg worrisome?
 - b. How do you think your back or leg discomfort will affect you in the future?

The final question

20. Anything else that you would like to share with us, which has not been covered in this interview?

References

1. Genevay S, Atlas SJ. Lumbar spinal stenosis. *Best Pract Res Clin Rheumatol* 2010;24:253-65.
2. Otani K, Kikuchi S, Yabuki S, et al. Lumbar spinal stenosis has a negative impact on quality of life compared with other comorbidities: an epidemiological cross-sectional study of 1862 community-dwelling individuals. *ScientificWorldJournal* 2013;2013:590652-9.
3. Katz JN, Harris MB. Clinical practice. Lumbar spinal stenosis. *N Engl J Med* 2008;358:818-25.
4. Tomkins-Lane C, Melloh M, Wong AYL. Diagnostic tests in the clinical diagnosis of lumbar spinal stenosis: consensus and results of an International Delphi study. *Eur Spine J* 2020;29:2188-97.
5. Ishimoto Y, Yoshimura N, Muraki S, et al. Prevalence of symptomatic lumbar spinal stenosis and its association with physical performance in a population-based cohort in Japan: the Wakayama Spine Study. *Osteoarthritis Cartilage* 2012;20:1103-8.

6. Costandi S, Chopko B, Mekhail M, Dews T, Mekhail N. Lumbar spinal stenosis: therapeutic options review. *Pain Pract* 2015;15:68-81.
7. Deyo RA, Mirza SK, Martin BI, Kreuter W, Goodman DC, Jarvik JG. Trends, major medical complications, and charges associated with surgery for lumbar spinal stenosis in older adults. *JAMA* 2010;303:1259-65.
8. Deyo RA, Gray DT, Kreuter W, Mirza S, Martin BI. United States trends in lumbar fusion surgery for degenerative conditions. *Spine (Phila Pa 1976)* 2005;30:1441-5.
9. Mannion AF, Denzler R, Dvorak J, Grob D. Five-year outcome of surgical decompression of the lumbar spine without fusion. *Eur Spine J* 2010;19:1883-91.
10. Martin BI, Mirza SK, Comstock BA, Gray DT, Kreuter W, Deyo RA. Reoperation rates following lumbar spine surgery and the influence of spinal fusion procedures. *Spine (Phila Pa 1976)* 2007;32:382-7.
11. Lurie JD, Tosteson TD, Tosteson A, et al. Long-term outcomes of lumbar spinal stenosis: eight-year results of the spine patient outcomes research trial (SPORT). *Spine (Phila Pa 1976)* 2015;40:63-76.
12. Ma X-L, Zhao X-W, Ma J-X, Li F, Wang Y, Lu B. Effectiveness of surgery versus conservative treatment for lumbar spinal stenosis: a system review and meta-analysis of randomized controlled trials. *Int J Surg* 2017;44:329-38.
13. Zaina F, Tomkins-Lane C, Carragee E, Negrini S, Zaina F. Surgical versus non-surgical treatment for lumbar spinal stenosis. *Cochrane Database Syst Rev* 2016;2016:CD010264.
14. Marchand A-A, Suitner M, O'Shaughnessy J, C-É Châtillon, Cantin V, Descarreaux M. Effects of a prehabilitation program on patients' recovery following spinal stenosis surgery: study protocol for a randomized controlled trial. *Trials* 2015;16:483.
15. Gometz A, Maislen D, Youtz C, et al. The effectiveness of prehabilitation (Prehab) in both functional and economic outcomes following spinal surgery: a systematic review. *Cureus* 2018;10:e2675.
16. Nielsen PR, Jørgensen LD, Dahl B, Pedersen T, Tønnesen H. Prehabilitation and early rehabilitation after spinal surgery: randomized clinical trial. *Clin Rehabil* 2010;24:137-48.
17. Lindbäck Y, Tropp H, Enthoven P, Abbott A, Öberg B. PREPARE: presurgery physiotherapy for patients with degenerative lumbar spine disorder: a randomized controlled trial. *Spine J* 2018;18:1347-55.
18. Marchand A-A, Suitner M, O'Shaughnessy J, C-É Châtillon, Cantin V, Descarreaux M. Feasibility of conducting an active exercise prehabilitation program in patients awaiting spinal stenosis surgery: a randomized pilot study. *Sci Rep* 2019;9:12257-13.
19. Marchand A-A, Houle M, O'Shaughnessy J, C-É Châtillon, Cantin V, Descarreaux M. Effectiveness of an exercise-based prehabilitation program for patients awaiting surgery for lumbar spinal stenosis: a randomized clinical trial. *Sci Rep* 2021;11:11080.
20. Topp RRNP, Swank AMP, Quesada PMP, Nyland JEPT, Malkani AMD. The effect of prehabilitation exercise on strength and functioning after total knee arthroplasty. *PM R* 2009;1:729-35.
21. Ditmyer MM, Topp R, Pifer M. Prehabilitation in preparation for orthopaedic surgery. *Orthop Nurs* 2002;21:43-51.
22. Carli F, Zavorsky GS. Optimizing functional exercise capacity in the elderly surgical population. *Curr Opin Clin Nutr Metab Care* 2005;8:23-32.
23. Nielsen PR, Andreassen J, Asmussen M, Tønnesen H. Costs and quality of life for prehabilitation and early rehabilitation after surgery of the lumbar spine. *BMC Health Serv Res* 2008;8:209.
24. McCarthy AE, Bove AM, Piva S, Mecca LP, Schneider MJ. A qualitative study of preparation for lumbar spinal stenosis surgery: perceptions of patients and physical therapists. *J Orthop Sports Phys Ther* 2020;50:198-205.
25. Lyle S, Williamson E, Darton F, Griffiths F, Lamb SE. A qualitative study of older people's experience of living with neurogenic claudication to inform the development of a physiotherapy intervention. *Disabil Rehabil* 2017;39:1009-17.
26. Bove AM, Lynch AD, Ammendolia C, Schneider M. Patients' experience with nonsurgical treatment for lumbar spinal stenosis: a qualitative study. *Spine J* 2018;18:639-47.
27. Lynch AD, Bove AM, Ammendolia C, Schneider M. Individuals with lumbar spinal stenosis seek education and care focused on self-management—results of focus groups among participants enrolled in a randomized controlled trial. *Spine J* 2018;18:1303-12.
28. Ammendolia C, Schneider M, Williams K, et al. The physical and psychological impact of neurogenic claudication: the patients' perspectives. *J Can Chiropr Assoc* 2017;61:18-31.
29. May S. Patients' attitudes and beliefs about back pain and its management after physiotherapy for low back pain. *Physiother Res Int* 2007;12:126-35.
30. Kiger ME, Varpio L. Thematic analysis of qualitative data: AMEE Guide No. 131. *Med Teach* 2020;42:846-54.
31. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol* 2006;3:77-101.
32. Hunt MR. Strengths and challenges in the use of interpretive description: reflections arising from a study of the moral experience of health professionals in humanitarian work. *Qual Health Res* 2009;19:1284-92.
33. McHugh ML. Interrater reliability: the kappa statistic. *Biochem Med (Zagreb)* 2012;22:276-82.
34. Fairbank JC, Pynsent PB. The Oswestry Disability Index. *Spine (Phila Pa 1976)* 2000;25:2940-52. discussion 2952.
35. Atlas A, Milanese S, Grimmer K, Barras S, Stephens JH. Sources of information used by patients prior to elective surgery: a scoping review. *BMJ Open* 2019;9:e023080.
36. Xu RH, Wong ELY. Involvement in shared decision-making for patients in public specialist outpatient clinics in Hong Kong. *Patient Prefer Adherence* 2017;11:505-12.
37. Diwan S, Sayed D, Deer TR, Salomons A, Liang K. An algorithmic approach to treating lumbar spinal stenosis: an evidenced-based approach. *Pain Med* 2019;20(Suppl 2):S23-31.
38. Comer C, Ammendolia C, Battié MC, et al. Consensus on a standardised treatment pathway algorithm for lumbar spinal stenosis: an international Delphi study. *BMC Musculoskelet Disord* 2022;23:550.
39. Elwyn G, Frosch D, Thomson R, et al. Shared decision making: a model for clinical practice. *J Gen Intern Med* 2012;27:1361-7.
40. Elwyn G, Laitner S, Coulter A, Walker E, Watson P, Thomson R. Implementing shared decision making in the NHS. *BMJ* 2010;341:34-973.
41. Lin ML, Huang CT, Chen CH. Reasons for family involvement in elective surgical decision-making in Taiwan: a qualitative study. *J Clin Nurs* 2017;26:1969-77.
42. Lam WHK, Bell MGH. *Advanced modeling for transit operations and service planning*. Amsterdam, London: Pergamon; 2003.
43. Peretti A, Amenta F, Tayebati SK, Nittari G, Mahdi SS. Telerehabilitation: review of the state-of-the-art and areas of application. *JMIR Rehabil Assist Technol* 2017;4:e7.
44. Palazzo C, Klinger E, Dorner V, et al. Barriers to home-based exercise program adherence with chronic low back pain: patient expectations regarding new technologies. *Ann Phys Rehabil Med* 2016;59:107-13.
45. Ng TK, Kwok CK, Ngan GY, et al. Differential effects of COVID-19 pandemic on physical activity involvements and exercise habits in people with and without chronic diseases: a systematic review and meta-analysis. *Arch Phys Med Rehabil* 2022;103:1448-65.e6.
46. Malmivaara A, Slätis P, Heliövaara M, et al. Surgical or nonoperative treatment for lumbar spinal stenosis? A randomized controlled trial. *Spine (Phila Pa 1976)* 2007;32:1-8.

47. Weinstein JN, Tosteson TD, Lurie JD, et al. Surgical versus non-operative treatment for lumbar spinal stenosis four-year results of the spine patient outcomes research trial. *Spine (Phila Pa 1976)* 2010;35:1329-38.
48. Lau KKL, Samartzis D, To NSC, Harada GK, An HS, Wong AYL. Demographic, surgical, and radiographic risk factors for symptomatic adjacent segment disease after lumbar fusion: a systematic review and meta-analysis. *J Bone Joint Surgery* 2021;103:1438-50.
49. Wong AYL, Karppinen J, Samartzis D. Low back pain in older adults: risk factors, management options and future directions. *Scoliosis Spinal Disord* 2017;12:14.
50. Wong CKW, Mak RYW, Kwok TSY, et al. Prevalence, incidence, and factors associated with non-specific chronic low back pain in community-dwelling older adults aged 60 years and older: a systematic review and meta-analysis. *J Pain* 2022;23:509-34.
51. Staud R, Robinson ME, Vierck CJ, Price DD. Diffuse noxious inhibitory controls (DNIC) attenuate temporal summation of second pain in normal males but not in normal females or fibromyalgia patients. *Pain* 2003;101:167-74.
52. Anderson C. Presenting and evaluating qualitative research. *Am J Pharm Educ* 2010;74:141.
53. Schmier JK, Halpern MT. Patient recall and recall bias of health state and health status. *Expert Rev Pharm Out Res* 2004;4:159-63.