Taylor & Francis
Taylor & Francis Group

Current Medical Research and Opinion

ISSN: 0300-7995 (Print) 1473-4877 (Online) Journal homepage: www.tandfonline.com/journals/icmo20

A new strategy for the selection of patients with hip osteoarthritis to avoid inappropriate total hip replacement based on imaging and clinical characteristics

Kazuo Hayashi, Yves Henrotin , Toshiharu Tsunoda & Shoji Tokunaga

To cite this article: Kazuo Hayashi, Yves Henrotin , Toshiharu Tsunoda & Shoji Tokunaga (24 Jun 2025): A new strategy for the selection of patients with hip osteoarthritis to avoid inappropriate total hip replacement based on imaging and clinical characteristics, Current Medical Research and Opinion, DOI: 10.1080/03007995.2025.2521097

To link to this article: https://doi.org/10.1080/03007995.2025.2521097

Published online: 24 Jun 2025.

CURRENT MEDICAL RESEARCH AND OPINION
https://doi.org/10.1080/03007995.2025.2521097
Article /2521097

Taylor & Francis
Taylor & Francis Group

REVIEW ARTICLE

OPEN ACCESS Check for updates

A new strategy for the selection of patients with hip osteoarthritis to avoid inappropriate total hip replacement based on imaging and clinical characteristics

Kazuo Hayashi[a], Yves Henrotin[b], Toshiharu Tsunoda[c] and Shoji Tokunaga[d]

[a]Arthritis Center, Fukuoka Wajiro Hospital, Fukuoka, Japan; [b]Department of Physical Activity and Rehabilitation Sciences, University of Liège, Liège, Belgium; Physical Therapy and Rehabilitation Department, Marche-en-Famenne, Belgium; [c]Department of Orthopaedic Surgery, Asama General Hospital, Saku City, Japan; [d]Medical Information Center, Kyushu University Hospital, Fukuoka, Japan

ABSTRACT

Background: Total hip replacement (THR) is extremely common and generally results in excellent patient satisfaction. However, 36% of patients with hip osteoarthritis who undergo THR reportedly experience long-term postoperative pain. Furthermore, only 20% of patients attempt exercise before surgery, despite the recommendation for 3–6 months of conservative treatment before surgery. Despite these facts, the number of THRs performed annually is currently increasing.

Objectives: To propose and discuss a new strategy based on clinical and radiological characteristics for selecting candidates for Pericapsular Soft Tissue and Pelvic Realignment (PSTP-R) therapies to avoid inappropriate THR.

Methods: The PubMed electronic database was searched to identify publications reporting data from clinical studies on the diagnosis and treatment of osteoarthritis in humans published between 1995 and 2023. This narrative review summarizes the findings of these previous studies.

Results: A previous study reported that PSTP-R therapy comprising pelvic realignment, muscle strengthening, and stretching was effective for patients with a Harris Hip Score (HHS) below 60 points, even those with complete loss of cartilage on radiography. A post hoc study showed that the risk of discontinuation of PSTP-R therapy increased with increasing frequency of pain in the buttock at baseline. Cartilage loss was not a risk factor for withdrawal from PSTP-R therapy.

Conclusion: Patients should be better informed regarding the benefits of THR and the possibility of persistent postoperative pain. If the patient has complete loss of cartilage on radiography but no buttock pain, PSTP-R therapy might improve their pain and avoid THR.

PLAIN LANGUAGE SUMMARY

The use of joint replacement to treat hip osteoarthritis (OA) is extremely common and generally results in excellent patient satisfaction. However, 36% of patients with hip OA reportedly experience long-term pain after joint replacement. Furthermore, only 20% of patients attempt exercise before surgery. Despite these findings, the number of joint replacements of the hip is currently increasing. Therefore, there is a need to better inform patients about the benefits of hip joint replacement and the possibility of persistent postoperative pain. In general, patients with severe disability due to hip OA have been considered candidates for joint replacement. However, our study showed that these patients improved with pericapsular soft tissue and pelvic realignment (PSTP-R) therapy comprising pelvic realignment derived from Shiatsu plus muscle strengthening and stretching, even those with complete loss of cartilage. The risk of discontinuation of PSPT-R therapy increased in accordance with the frequency of buttock pain at baseline. Cartilage loss on radiography was not a risk factor for withdrawal from PSPT-R therapy. If the patient has a complete loss of cartilage on radiography but no buttock pain, PSTP-R therapy might improve their pain and avoid hip joint replacement. Clinical characteristics as well as radiological characteristics such as complete loss of cartilage on radiography may be useful to select patients with hip OA who are suitable for PSTP-R therapy to avoid inappropriate hip joint replacement.

ARTICLE HISTORY

Received 21 March 2025
Revised 22 May 2025
Accepted 12 June 2025

KEYWORDS

Hip; osteoarthritis; total hip replacement; pericapsular soft tissue and realignment therapy; pelvic realignment; education; clinical characteristics

CONTACT Kazuo Hayashi kzo.hys.aoba.52120@gmail.com Arthritis Center, Fukuoka Wajiro Hospital, 2-2-75 Wajirooka, Higashi-ku, Fukuoka 811-0213, Japan

Introduction

In 2010, the prevalence of total hip replacement (THR) in the total United States population was 0.83%.[1] Compared with the number of THRs performed in 2014, the number of THRs in the United States is predicted to increase by 75% in 2025, 129% in 2030, and 284% in 2040.[2] Although THR is highly successful when evaluated by the surgeon,[3] many patients experience long-term postoperative pain.[4,5] More precisely, Beswick et al.[4] and Judge et al.[5] reported that 36% of patients experience long-term postoperative pain after THR. Similarly, our group confirmed that 30.7% of our patients had postoperative pain 7 months after THR.[6] Muscle weakness, proprioception, and balance deficits exhibited by patients after THR are also essential problems. Therefore, it is important to better identify patient candidates for THR to avoid long-term postoperative pain, muscle weakness, proprioception, and balance deficits after surgery, and identify those who could benefit from a rehabilitation program. For this purpose, we implemented a preoperative rehabilitation program including muscle strengthening and stretching, functional training, and aerobic fitness. We observed that this exercise program, following the published guidelines,[7–9] had poor results for patients with severe disability corresponding to a Harris Hip Score (HHS)[10] of less than 60 points.[11] Therefore, we implemented an alternative exercise program based on Shiatsu practice for these patients.[12] This exercise program, which includes pericapsular soft tissue and pelvic realignment (PSTP-R) therapies, improved the algo-functional status of these patients.[13–18]

In general, patients with severe disability due to hip osteoarthritis (OA) and complete loss of cartilage on radiography have been considered candidates for THR. However, it is important to identify the clinical markers of candidates for THR who will respond to PSTP-R therapy. Our reflection was built on the following prerequisites.

1. Criteria used to select candidates for THR[19] are not universally accepted, and concerns remain about the usefulness of the existing criteria.[20] In an international cross-sectional study including 1909 patients, Gossec et al.[19] reported that arthroplasty was recommended for 574 of 779 patients (73.7%) with hip OA. However, although the symptom severity was greater in patients recommended for THR, pain and functional disability alone did not discriminate between those who were and were not considered to need THR by the orthopedic surgeons. Surgeons often decided that surgery was warranted even in less symptomatic patients (50% of patients in the lowest decile of symptoms were recommended for THR) or that surgery was not warranted even if symptoms were severe (only 75% of these patients were considered surgical candidates). The authors noted that surgeons paid more attention to radiographic severity than to symptom intensity. Huynh et al.[21] confirmed that surgeons selected THR primarily based on radiographic severity rather than pain and functional limitations. Gossec et al.[19] and Huynh et al.[21] evaluated radiographic joint space narrowing (JSN) to investigate factors associated with the orthopedic surgeon's decision to recommend THR. There is a need to investigate the relationship between the imaging and clinical characteristics of the patients to establish a strategy for selecting candidates for PSTP-R therapy.
2. Pain in OA is multifactorial, and no relationship exists between radiographic features and symptom severity. New imaging data suggest that pain arises from all structures in the joint and that cartilage loss is only a minor contributor to pain symptoms.[22] Bacon et al.[23] reported that cartilage loss evaluated by magnetic resonance imaging was not strongly associated with the worsening of knee pain. We agree with the report by Wu et al.,[24] which concludes that a relationship between worsening cartilage loss and worsening pain must be established in cases of severe OA before hip arthroplasty is considered. We need to investigate the relationship between cartilage loss on radiograph and various pain characteristics to achieve better pain relief and function with PSPT-R therapy and avoid inappropriate THR.
3. Our clinical observation revealed that the patients responding to PSTP-R therapies had pain when standing and when taking the first steps after standing up, and that this pain decreased as they continued to walk; in contrast, the patients who did not improve with PSTP-R therapies and required surgery had more intense and persistent pain when walking than when standing or taking the first few steps.[18] We named the former group as patients with "standing-up pain" and the latter group as patients with "walking pain".
4. Most studies that have examined exercise as a non-surgical treatment for hip OA have involved muscle strength training, stretching, functional training, and aerobic fitness and have reported that exercise showed no improvement of symptoms and function in patients with severe

disability corresponding to an HHS below 60 points.[25] Bennel et al.[26] reported that among adults with painful hip OA ($N = 46$), physical therapy did not result in greater improvement in pain or function compared with sham treatment ($N = 53$), raising questions about its value for these patients. Furthermore, a meta-analysis provided low to moderate evidence that exercise intervention resulted in pain reduction before THR.[27] In contrast, Ageberg et al.[28] reported that participation in a neuromuscular training program for a median of 11 weeks before THR decreased pain intensity in patients with severe primary OA of the hip. Dahlberg et al.[29] reported that a 24-week digital self-management program decreased pain measured by a numerical rating scale in patients with severe hip OA. However, these two studies did not analyze the relationship between radiographic severity and pain levels in long- term follow-up. In addition, the response of "standing-up pain" patients with severe disability and cartilage loss on radiography to strength training, stretching, functional training, and aerobic fitness should be investigated in detail to make the cause of the no significant effect of those conventional therapy to those patients clear and establish a strategy to avoid inappropriate THR.

5. In a previous paper, we found that PSTP-R therapies improved the HHS in patients with unilateral or bilateral hip OA, even in those with an HHS below 60 points and complete loss of joint space on radiography (Figure 1).[17] Fernandes et al.[30] and Svege et al.[31] reported that an HHS below 60 points has been used as a criterion for THR, and they excluded patients with an HHS below 60 points in their exercise studies.

This means that strength training and stretching including pelvic realignment can improve the patients with an HHS < 60 points. It seems that an HHS below 60 points is not a criterion for THR. There is a need to decrease the cases with inappropriate THR to avoid long-term postoperative pain after surgery.

The present opinion paper aimed to propose and discuss a strategy for selecting candidates for PSTP-R therapies and to avoid inappropriate THR based on clinical and radiographic markers such as complete loss of cartilage on radiography. This opinion was formed based on a review of the literature, the expertise of the authors, and the results of a post hoc analysis of a Japanese cohort aiming to evaluate the influence of preoperative pain and clinical and radiographic characteristics on the outcomes of THR candidates treated with PSTP-R therapy.[17,18,32]

Methods

A narrative review of the literature was carried out by searching the titles and abstracts of the PubMed electronic database for publications reporting data from clinical studies on the diagnosis and treatment of OA in humans published between 1995 and 2023. The following search equation was used to identify potentially relevant publications: ("osteoarthritis"[MeSH Terms] OR "osteoarthritis"[TIAB] OR "arthrosis"[TIAB]) AND ("hip"[MeSH Terms] OR "Osteoarthritis, Hip/therapy"[MAJR] OR "total hip replacement"[MeSH Terms] OR "total joint replacement"[MeSH Terms]) AND ("Exercise Therapy/methods"[MeSH] OR "Physical Therapy Modalities"[MAJR]) AND ("pelvic alignment" OR "limb length discrepancy") AND ("after, continue, post, recur, ongoing, chronic, persistent, OR long term") AND "pain" AND ("risk, predict, factor, associated, correlate, effect, affect OR influence"). Our search of terms was restricted to the articles' titles or abstracts. The identified publications were then selected in a stepwise manner by K.H. First, the publication had to be in English. Second, the publication had to present data on humans with OA. Third, the publication had to present clinical trials. Papers discussed in this review were then selected based on the author's evaluation of its content and, finally, discussed.

Recommendations for the management of hip OA

In 2018, the Osteoarthritis Research Society International published recommendations that take into account the presence of comorbidities such as diabetes or cardiovascular disease.[33] For hip OA, the core treatment is non-pharmacological, irrespective of the patient's age, OA severity, and general condition. The recommended non-pharmacological treatments are education on OA and lifestyle change, regular physical activity, including land-based structured exercise programs, and dietary weight management if the patient is overweight or obese. Medications are useful for managing pain and facilitating physical activity. For OA of the hip, the primary option is oral conventional non-steroidal anti-inflammatory drugs (NSAIDs) for patients with no comorbidities, and cyclooxygenase-2 inhibitors for those with gastrointestinal disorders. However, the concern is that few patients adhere to non-pharmacological treatments and directly resort to oral NSAIDs, which can have serious consequences for their health. In general, if a patient's pain is not

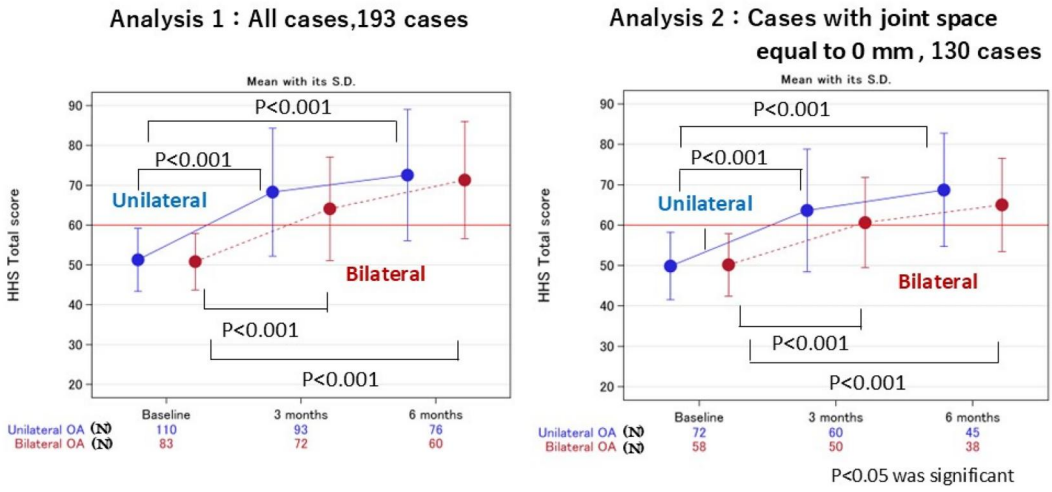

Figure 1. Change in the HHS from baseline in patients with hip OA and an HHS <60 points at baseline. The unilateral group denotes patients with OA of the hip on one side only with no pain in the contralateral hip. The bilateral group denotes patients with OA and pain in both hips. A *p*-value <0.05 (paired *t*-test, McNemar's test) was considered statistically significant. HHS; Harris Hip Score; MJS; minimal joint space; OA; osteoarthritis; SD; standard deviation.

relieved by NSAIDs, they consult a surgeon who offers them conservative surgery or THR.[34]

Pelvic, lumbar, and lower limb malalignment associated with hip OA

Most patients with hip OA and an HHS of <60 points showed elevation of the greater trochanter and the medial malleolus of the ankle on standing full-length radiographs of the affected side compared with the contralateral side.[17] These patients also tilt the trunk forward because this posture relieves their pain.

Another study identified a decrease in the hip extension angle and an increase in the anterior pelvic tilt and lumbar lordosis in patients with hip OA.[35] It has been suggested that the anterior pelvic tilt compensates for the reduction in coverage of the acetabulum. This mechanism is also thought to cause retraction of the psoas and rectus femoris muscles, resulting in a hip flexion posture at a later stage.

Tilting the trunk forward causes a shift in the counterforce from the floor to the posterior compartment of the acetabulum. This force causes anterior pelvic tilt and elevation of the greater trochanter, resulting in functional (apparent) limb length shortening on the side of the affected hip (Figure 2).

Brekke et al.[36] reported that anterior pelvic tilt was significantly greater in patients with symptomatic acetabular retroversion than in the general population. The prevalence of acetabular retroversion, whether unilateral or bilateral, was 24% in their controls. They proposed that the position of the pelvis should be considered when treating patients with hip pain because their pain may be related to the functional position of the pelvis and not necessarily solely the result of radiographic acetabular retroversion. This observation is in line with the view that exercise therapy to correct excessive anterior pelvic tilt should be considered before surgery. Unfortunately, no good quality studies demonstrate the impact of non-surgical treatment aiming at reducing excessive anterior pelvic tilt on hip OA symptoms.[37]

We also found that most patients with moderate to severe hip OA had pain or stiffness of the erector spinal muscle on the affected side (Figure 3).[17] Using surface electromyography, Moreside et al.[38] investigated the erector spinae muscle in 19 patients with severe hip OA, 20 with moderate hip OA, and 19 with asymptomatic hip OA during treadmill walking and found that erector spinae activity during the swing phase of gait increased significantly with increasing severity of OA. They also found a significant increase in activity of the ipsilateral erector spinae muscle when standing in patients with severe hip OA, and an increase in sagittal and frontal trunk motion when walking in those with moderate or severe hip OA. Another study found that patients with moderate or severe hip OA had pain or stiffness in the erector spinae muscle on the affected side when they stood up after being seated for a period of time and attributed this to anterior pelvic tilt and lumbar lordosis.[39]

Limb length discrepancy is a risk factor for hip OA

Kim et al.[40] reported that a limb length discrepancy (LLD) of $\geq$ 2 cm increases the risk of hip OA on the

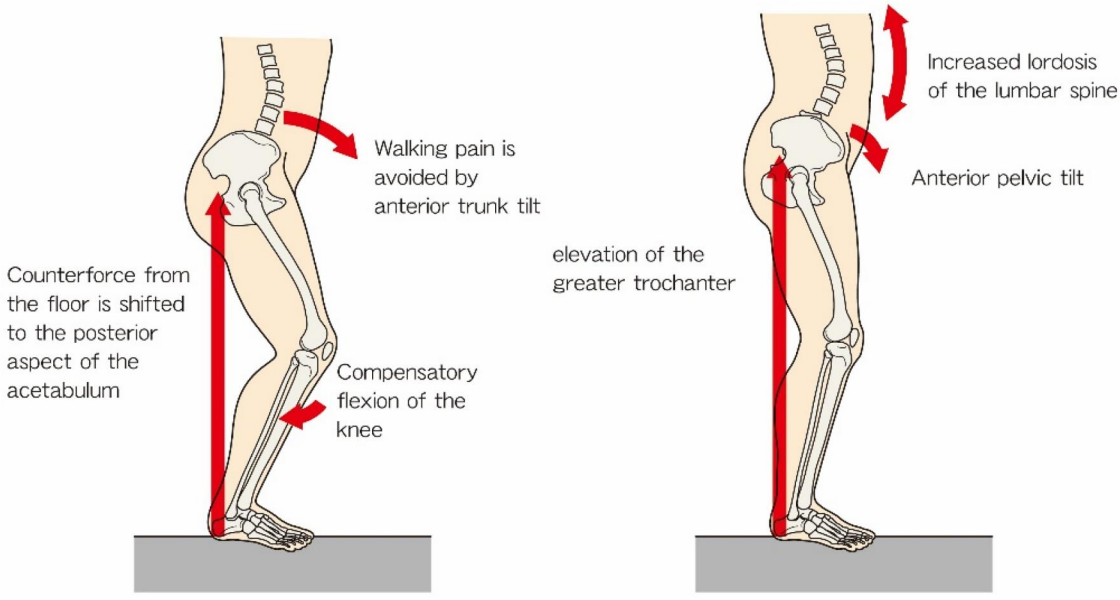

Figure 2. (A) Pain when standing and walking is avoided by tilting the trunk forward, irrespective of whether the pain is of the "standing-up" type or the "walking" type. (B) The counterforce from the floor is shifted to the posterior aspect of the acetabulum. This force causes anterior pelvic tilt and lumbar lordosis.

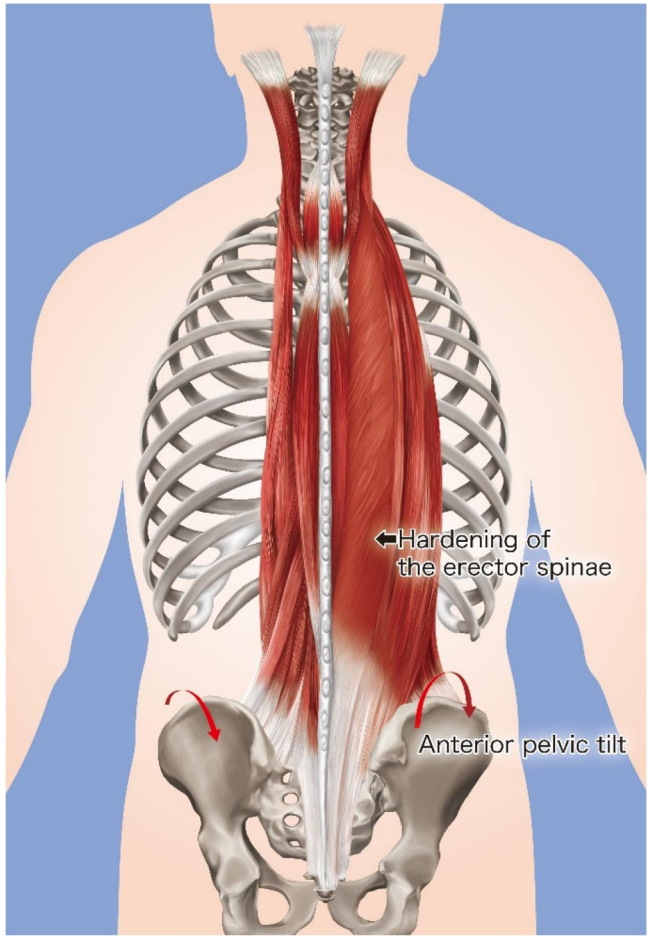

Figure 3. Anterior pelvic tilt and elevation of the greater trochanter in patients with painful hip OA caused by apparent shortening of the leg on the affected side. This functional limb length discrepancy causes stiffening of the erector spinae muscle on the affected side, resulting in limping, which causes repetitive injury to the pericapsular soft tissue (joint capsule, ligaments, inner muscles) and results in contracture of the joint.

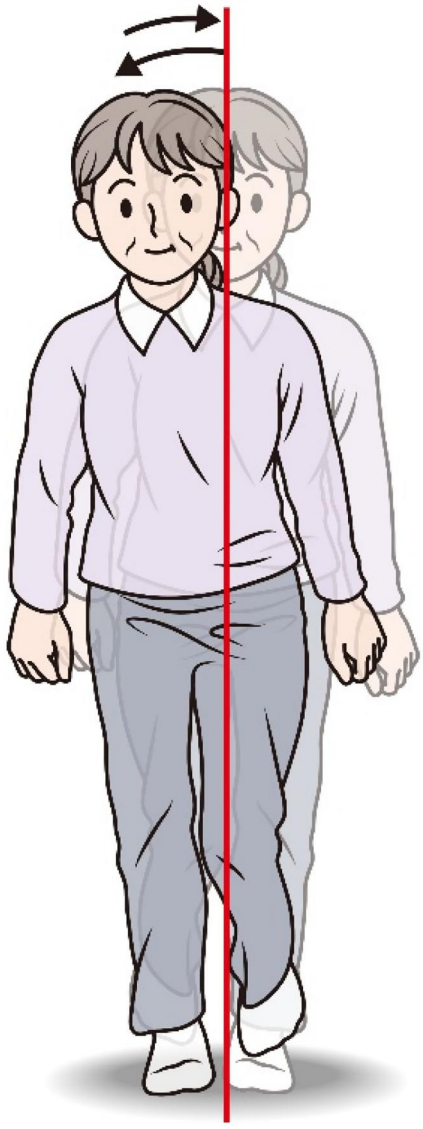

Figure 4. Pelvic malalignment secondary to narrowing or disappearance of the joint space causes functional limb length discrepancy, resulting in limping, which increases pain in the affected joint. Many patients with severe hip osteoarthritis complain of pain in areas other than the affected joint, including the foot, ankle, calf, thigh, and lumbar spine.

side with the shorter limb and that equalizing limb length may reduce that risk. A systematic review by Khamis and Carmeli[41] revealed a significant relationship between LLD and limping and that more severe limping and compensatory strategies occur with increasing LLD. Their review also found evidence that limping can start at a discrepancy of >1 cm and worsens as the LLD increases, causing pain and joint instability.

Warren et al.[42] stated that pelvic torsion is common in LLD and occurs when one iliac bone is tilted forward and the other is tilted backward. Schamberger et al.[43] also found that asymmetric torquing force resulting from LLD on a hip joint can cause rotational malalignment of the pelvis and can affect the pelvis on one side only. However, it is more likely that this rotational malalignment of the pelvis is associated with compensatory rotation of the contralateral side of the pelvis in the opposite direction (this mechanism is shown in the Supplementary Materials, Appendix 1 in ref.)[32]

No consensus exists about which abnormality appears first: hip OA, LLD, or pelvic tilt. We hypothesize that two scenarios may exist or co-exist, namely, (1) hip OA may be secondary to LLD and pelvic torsion caused, for example, by morphological malalignment or trauma, or (2) hip OA can be the cause of LLD and pelvic torsion.[39]

We found that pelvic malalignment secondary to JSN caused LLD, resulting in limping (Supplementary Information, Appendix 2 in ref.)[17] Our retrospective study of 1,077 cases found that most patients with hip OA had anterior pelvic tilt and apparent shortening of the lower extremity on the affected side.[11,15] This limb shortening appeared to cause limping, which in turn caused repetitive injury to the pericapsular soft tissues, including the joint capsule, ligaments, and inner muscles, resulting in joint stiffness. The impaired gait not only increases pain in the affected joint but may also be responsible for painful lesions in tissues of other joints, including the foot, ankle, calf, thigh, and lumbar spine, as a consequence of the compensatory mechanisms (Figures 2 and 3).

Standard rehabilitation before THR surgery

The NICE Guideline Center (London) stated that for many people who underwent hip replacement, their recovery is difficult, prolonged, and often painful. Symptoms generally improve with time, but some patients never regain optimal function of their joints. People planning to undergo joint replacement should participate in preoperative rehabilitation programs as one possible way to optimize postoperative recovery, but there are no recommended national standards for such programs.[44]

A literature search was conducted to identify randomized controlled trials (RCTs) comparing the effectiveness of individualized preoperative rehabilitation programs versus no program or usual care for patients awaiting primary elective THR. Eight RCTs were included in this review.[45–52] Individualized preoperative rehabilitation programs were offered and included multiple sessions, prescribed and supervised exercises, and counseling by a member of the rehabilitation team. The exercise

content included muscular strength training in the majority of studies. These studies found no clinically important difference between individualized preoperative rehabilitation programs and usual care for pain, but provided evidence for an important benefit of individualized preoperative rehabilitation programs in terms of the duration of hospitalization.

Shiatsu to treat musculoskeletal disorders

Robinson et al.[12] defined Shiatsu as a complementary and alternative medicine primarily developed in Japan. In the Japanese language, Shiatsu means "finger pressure," but uses gentle manipulation, stretches, and pressure applied using the fingers, thumbs, elbows, knees, and feet.[12] The systematic review by Robinson et al.[12] identified nine Shiatsu studies, including one RCT, three controlled non-randomized, one within-subjects, one observational, and three uncontrolled studies investigating the effects of Shiatsu on mental and physical health. Despite the poor quality of the studies, the authors concluded that evidence was improving in quantity, quality, and reporting but that more research was needed. Shiatsu therapy has been practiced in Japan for approximately 100 years, and many specific techniques have been developed. However, there have been no reports in the academic literature of Shiatsu as a treatment for OA.

Shiatsu is also practiced in many European countries but varies in style, philosophical approach, and theoretical basis.[53,54] Overall, Shiatsu, as practiced in Europe, aims to balance, restore, and maintain the body's energy balance and prevent the build-up of stress. The most common conditions presenting for treatment are musculoskeletal and psychological problems.[55]

Development of a new pelvic realignment therapy to alleviate pain and improve function in patients with hip OA

Hayashi and Tsunoda[11] introduced a pelvic realignment therapy program derived from Shiatsu in 2007 for treating hip OA because the recommended stretching and strengthening exercise program failed to improve candidates for THR with an HHS <60. Pelvic realignment therapies aim to treat the stiffened or contracted spine erector muscle and to correct LLD in patients with moderate to severe hip OA. We expected that LLD could be corrected by the relaxation of the contracted spine erector muscle with Shiatsu therapy. (Figures 3 and 4 in this study; Supplementary Materials, Appendix 1 and 2 in ref. [32])

We named this program PSTP-R therapy and demonstrated its effects for patients with hip OA in a retrospective study of 1077 cases recruited between 2011 and 2014.[15] The results revealed that many patients with severe hip OA experienced a more significant decrease in pain with PSTP-R therapy than with conventional and recommended pelvic and lower limb muscle stretching and gluteus medius strengthening.

In a prospective study conducted between 2017 and 2020, we showed that PSTP-R therapy was effective for patients with unilateral or bilateral hip OA and an HHS <60 points, even in those with complete loss of joint space[17] (Figure 1). In patients with unilateral hip OA, the HHS and other secondary endpoints, including the numeric rating scale score, 36-point quality of life score, and Timed Up and Go test result, were significantly improved by PSTP-R therapy.[56,57]

Strategy to avoid THR for patients with complete loss of cartilage on radiography and no pain in the buttock at baseline

We propose a decision-making strategy starting at least 6 months before surgery for patients with an HHS below 60 points. The post hoc study of our original main study showed that the risk of discontinuation of PSTP-R therapy was increased in patients with pain in the buttock at baseline. Cartilage loss on radiography was not a risk factor for withdrawal from PSPT-R therapy (worsening of symptoms, request for surgery, request for discontinuation of PSTP-R therapy) in patients with an HHS < 60 points.[32] Therefore, we integrated this sign into our decision-making algorithm. This therapeutic algorithm was designed based on the authors' experience and on the data collected since 2017.[17,32] If the patients have incomplete JSN, 3 months of PSTP-R is proposed. If the patients do not show an HHS change from baseline of between 0 and 10 points, an additional 3 months of PSTP-R therapy is performed. If the symptoms persist, THR or osteotomy is considered. If there is complete cartilage loss on radiography but no buttock pain, 3 months of PSTP-R therapy is carried out; if there is no improvement in symptoms (less than 10 points in the HHS), surgery is considered. If complete cartilage loss on radiography is associated with pain in the buttock, THR is considered if this is the wish of patient; however, if the patient wants to delay surgery for a second 3-month period, PSTP-R therapy is implemented (Figure 5). Among patients who continued PSTP-R therapy for

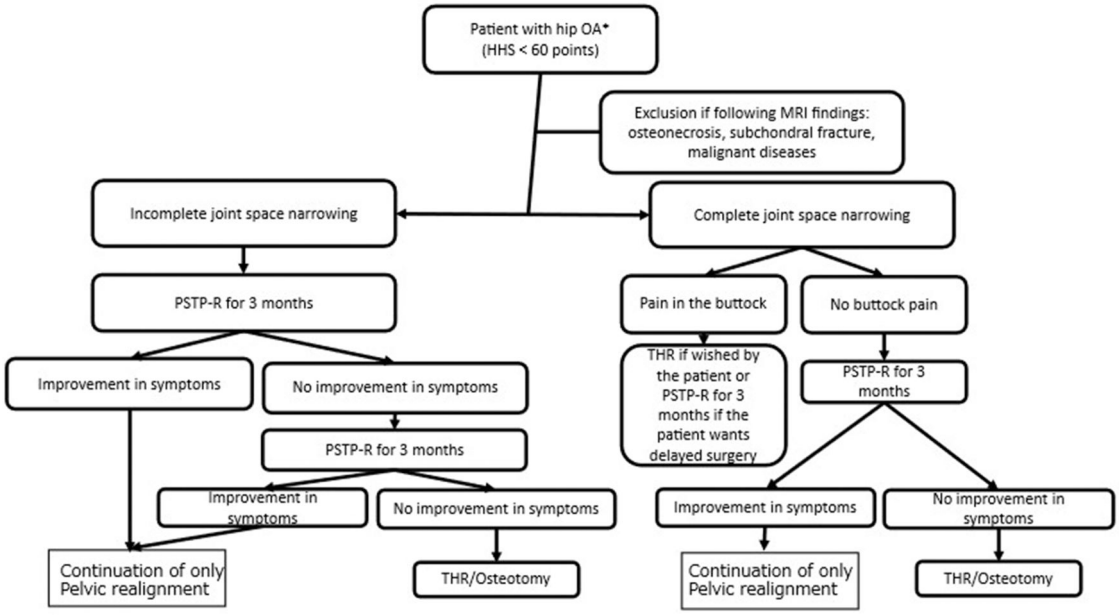

Figure 5. Strategy for patients with radiographic cartilage loss using imaging findings and baseline patient characteristics. The strategy changes based on whether the patient improves with PSTP-R therapy or needs THR. OA: osteoarthritis; HHS: Harris Hip Score; MRI: magnetic resonance imaging; PSTP-R: pericapsular soft tissue and pelvic realignment; THR: total hip replacement. *Patients were classified into two groups: a Unilateral OA group (no pain [HHS pain score of 44 points] in the opposite hip) and a Bilateral OA group (pain in both hips, HHS pain score below 40 points, bilaterally). In the Bilateral OA group, the side of the hip with lower HHS pain score targeted for analysis was evaluated.

6 months, a lower Kellgren-Lawrence (K/L) grade[58] at baseline was associated with a good response to PSTP-R therapy.[32]

Discussion

Numerous papers report that a large proportion of patients show long-term pain persistence after THR. This narrative review indicated that orthopedic surgeons should pay greater attention to preoperative pain (especially pain characteristics) than to radiographic severity. The post hoc study of our previous main study suggests that patients with hip OA and no pain in the buttock respond to PSTP-R therapy, especially patients with lower K/L grades. Inversely, patients with pain in the buttock do not improve with PSTP-R therapy and require surgery.

We recognize that this statement is based on an observational study and should be confirmed in a larger cohort, but it raises several questions. First, it raises the question of whether the current criteria are appropriate for deciding on THR. In general, surgeons follow guidelines recommending the use of medical imaging criteria to make a decision and do not sufficiently consider clinical criteria in their decision-making process.[21] Our previous studies indicate that clinical and imaging criteria should probably be integrated into the surgeons' decision-making algorithms.[17,32] Second, using response to rehabilitation as a decision criterion is questionable. Some guidelines suggest performing 3–6 months of rehabilitation, including structured land-based exercises, before considering surgery.[59] Ideally, hands-on and hands-off modalities should be offered to the patient before surgery to aid in decision-making regarding THR and reduce the likelihood of patient dissatisfaction with the outcome after surgery. Third, this review highlights the importance of better informing patients about the benefits of exercises and the risks of persistent pain after THR before considering surgery. In 2022, the Osteoarthritis Research Society International published an infographic indicating that only 20% of patients attempted exercise before surgery.[60] We consider that there is a need for more validated pain questionnaires (indexes) to differentiate the patients with hip OA into likely responders to PSTP-R therapy and candidates for THR to reduce the incidence of persistent pain after THR. Furthermore, as mentioned in our previous study,[32] we consider that questionnaires asking patients to report just the existence of pain cannot differentiate between responders and non-responders to PSTP-R therapy, and that further investigation is warranted to investigate the location of pain and to investigate the relationship between change patterns in pain intensity from standing up to walking and the response to PSTP-R therapy.

This position paper also highlights the efficacy of a specific manual therapy protocol, namely the PSTP-R

program, which includes hands-on and hands-off components. This protocol aims to correct compensatory mechanisms in patients with severe hip OA using elements of Shiatsu therapy and acts on the periarticular soft tissues. We speculate that PSTP-R therapies decrease the nociceptive influx from periarticular soft tissue. It would be interesting to investigate the long-term effects of this program on walking pain and structural damage. Indeed, we can anticipate that rebalancing of soft tissue tension would reduce the compensatory mechanisms and gait abnormalities and the ensuing mechanical stress applied to the joint in patients with walking pain. Of course, other approaches besides PSTP-R therapies such as stable shoes, heel lifts, and foot insoles should be considered to correct LLD and realign the malalignment of the lower extremity.[61,62]

In the future, studies comparing the long-term effectiveness of PSTP-R therapy in relation to the pain characteristics of patients with hip OA should be performed to better select those that should be enrolled in a PSTP-R program. In addition, there is a need to establish a more detailed "Pain Index" and investigate the relationship between the imaging and clinical characteristics of this more detailed "Pain Index".

Strength and limitations

The strength of this positioning paper is that we demonstrated the evidence in which cartilage loss on radiography was not a risk factor for withdrawal from PSPT-R therapy (worsening of symptoms, request for surgery, request for discontinuation of PSPT-R therapy), and buttock pain at baseline was most associated with discontinuation of PSPT-R therapy in patients with an HHS $<$ 60 points.[32] So orthopedic surgeons should pay more attention to symptom intensity, and not only take surgery decision based on radiographic OA severity, such as cartilage loss on radiography. This strategy has been developed since 2007 under the following the data of two cohorts on OA pain in moderate to severe hip OA (a Harris Hip Score: HHS $<$ 60 points). One is "standing-up pain" cohort in which patients are improved with PSTP-R therapy[17,32] and foot realignment with stable shoes.[61,62] Another is "walking pain" cohort in which those are not improved with these therapies and require surgery. The limitations of this study are that we could not present the method to differentiate the pain characteristics between "standing-up pain" and "walking pain" in the previous study.[17,32] Therefore, we plan to investigate the study to demonstrate the evidence of the existence of "standing-up pain" and "walking pain" in the next clinical trial.

In addition, the data of our studies were obtained from a single-arm observational study performed in two study centers. Due to the single-arm study design, a part of the results may be caused by the phenomenon "regression to the mean." Our findings require validation in multicenter, large-scale studies with a randomized controlled design, and long-term follow-up.

In this stage, the purpose of our study is to establish the appropriate selection of the candidates for THR to avoid the long-term postoperative pain.

Economic considerations

If the evidence of our hypotheses regarding "standing-up pain" and "walking pain" and realignment therapy system to avoid inappropriate THR is established, cost-effectiveness on the management of hip OA will remarkably become to be higher.

As we mention in the beginning of Introduction, numbers of THRs are currently increasing and will be remarkable more increase in future. This strategy may play an important role in cost-effectiveness in this field.

Conclusion

This opinion paper proposes a strategy to identify patients candidates for the PSTP-R program to avoid inappropriate THR. It also identifies the possible predictive factors for the discontinuation of PSTP-R therapy. Pain in the buttock at baseline was associated with a poor response to PSTP-R therapy, while a lower K/L grade at baseline was associated with a good response.

If the patient has a complete loss of cartilage on radiography but no buttock pain, PSTP-R therapy might improve their pain and avoid THR. In addition, if the patient has a lower K/L grade on radiography, they might achieve better pain relief and function with PSTP-R therapy. However, THR should be considered if complete loss of cartilage is associated with pain in the buttock. Therefore, we propose that patients should be screened using these criteria before considering surgery for THR, and that PSTP-R therapy should be reserved for those without pain in the buttock. PSTP-R therapy contributes to decreasing pain but also to correcting compensatory mechanisms and gait pattern abnormalities that result from LLD caused by pelvic malalignment. This approach could favor a reduction in the rate of patient dissatisfaction after THR. Finally, we think that patients should be better

informed regarding the risk of long-term pain after THR and the benefits of manual therapy.

Transparency

Declaration of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of financial/other relationships

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties. Peer reviewers on this manuscript have no relevant financial or other relationships to disclose.

Author contributions

K. Hayashi contributed to the study design, collection, analysis, and interpretation of data, drafting and revising of the manuscript. Y. Henrotin contributed to, analysis, critical revision of the manuscript, and writing the Discussion. T. Tsunoda contributed to the explanations of "Questionnaire for evaluation of pain from standing-up to walking." S. Tokunaga contributed to critical revising of the manuscript. All authors approved the final version of the manuscript.

Acknowledgements

The materials and ideas in this presentation were accumulated over time by clinical experience and prospective clinical trials. We appreciated the contributions of work colleagues (orthopedic surgeons, physical therapists, nurses, and medical clerks, statistical analysts). We are also grateful to Belinda Lawford from the team that won the 2022 OARSI infographic award for providing resource material relevant to this study and to Ross A. Hauser at Caring Medical, Fort Myers, FL, USA for providing us with the information on anterior pelvic tilt and functional limb length discrepancy. Finally, we thank Kelly Zammit, BVSc, from Edanz (https://jp.edanz.com/ac) for editing a draft of this manuscript.

ORCID

Kazuo Hayashi http://orcid.org/0000-0003-1056-9105

References

[1] Kremers HM, Larson DR, Crowson CS, et al. Prevalence of total hip and knee replacement in the United States. J Bone Joint Surg Am. 2015;97(17):1386–1397. https://journals.lww.com/jbjsjournal/abstract/2015/09020/prevalence_of_total_hip_and_knee_replacement_in.2.aspx doi: 10.2106/JBJS.N.01141.

[2] Singh JA, Yu S, Chen L, et al. Rates of total joint replacement in the United States: future projections to 2020-2040 using the national inpatient sample. J Rheumatol. 2019;46(9):1134–1140. doi:10.3899/jrheum.170990.

[3] Ng CY, Ballantyne JA, Brenkel IJ. Quality of life and functional outcome after primary total hip replacement: a five-year follow-up. J Bone Joint Surg Br. 2007;89(7):868–873. doi:10.1302/0301-620X.89B7.18482.

[4] Beswick AD, Wylde V, Gooberman-Hill R, et al. What proportion of patients report long-term pain after total hip or knee replacement for osteoarthritis? A systematic review of prospective studies in unselected patients. BMJ Open. 2012;2(1):e000435. doi:10.1136/bmjopen-2011-000435.

[5] Judge A, Cooper C, Williams S, et al. Patient-reported outcomes one year after primary hip replacement in a European Collaborative Cohort. Arthritis Care Res (Hoboken). 2010;62(4):480–488. doi:10.1002/acr.20038.

[6] Hayashi K, Nakashima Y, Inadome T, et al. The study of a hydroxyapatite-coated prosthesis for total hip replacement. J West Jpn Soc Orthopedics Traumatol. 1994;43(1):96–99. doi:10.5035/nishiseisai.43.96.

[7] Hochberg MC, Altman RD, Brandt KD, et al. Guidelines for the medical management of osteoarthritis. Part 1. Osteoarthritis of the hip. Arthritis Rheum. 1995;38(11):1541–1546. doi:10.1002/art.1780381104.

[8] American College of Rheumatology Subcommittee on Osteoarthritis Guidelines. Recommendations for the medical management of osteoarthritis of the hip and knee: 2000 update. Arthritis Rheum. 2000;43:1905–1915. doi:10.1002/1529-0131(200009)43:9<1905::AID-ANR1>3.0.CO;2-P.

[9] Roddy E, Zhang W, Doherty M, et al. Evidence-based recommendation for the role of exercise in the management of osteoarthritis of the hip and knee—the MOVE consensus. Rheumatology (Oxford). 2005;44(1):67–73. doi:10.1093/rheumatology/keh399.

[10] Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty: an end-result study using a new method of result evaluation. J Bone Joint Surg Am. 1969;51(4):737–755. https://journals.lww.com/jbjsjournal/abstract/1969/51040/Traumatic_Arthritis_of_the_Hip_after_Dislocation.12.aspx

[11] Hayashi K, Tsunoda T. New strategies for development of home exercise to prevent surgery in patients with hip osteoarthritis: considerations of pericapsular soft tissue as a pain generator. Acta Sci Orthop. 2019;2:14–19. https://actascientific.com/ASOR/pdf/ASOR-02-0042.pdf

[12] Robinson N, Lorenc A, Liao X. The evidence for Shiatsu: a systematic review of Shiatsu and acupressure. BMC Complement Altern Med. 2011;11(1):88. doi:10.1186/1472-6882-11-88.

[13] Hayashi K, Nakaniwa D, Haruguchi K, et al. Clinical trial of Yuki exercise program to prevent or postpone surgery for patients with hip osteoarthritis. J West Jpn Soc Orthopedics Traumatol. 2015;64:725–729. doi:10.5035/nishiseisai.64.725.

[14] Hayashi K, Ooyati T. Dramatic effects of a new home exercise to improve hip function for patients with

osteoarthritis. Osteoarthritis Cartilage. 2015;23:A165–6. doi:10.1016/j.joca.2015.02.929.

[15] Hayashi K, Tokunaga S, Haruguchi K, et al. Dramatic effects of new home exercises for patients with osteoarthritis of the hip: pericapsular soft tissue and realignment exercises. J Physiother Phys Rehabil. 2018;3:162–173. doi:10.4172/2573-0312.1000162.

[16] Hayashi K, Tsunoda T. Pericapsular soft tissue as a pain generator in hip osteoarthritis: considerations for developing a new home exercise to prevent surgery. Physiother Res Rep. 2018;1(2):1–3. doi:10.15761/PRR.1000111.

[17] Hayashi K, Tsunoda T, Tobo Y, et al. Effects of pericapsular soft tissue and realignment exercises for patients with osteoarthritis of the hip and Harris Hip Score below 60 points. Curr Med Res Opin. 2022;38(9):1567–1578. doi:10.1080/03007995.2022.2088716.

[18] Tsunoda T, Hayashi K, Tobo Y, et al. Evaluation of osteoarthritis questionnaire check list to select pain that can be alleviated with exercise in patients with hip osteoarthritis and harris hip score below 60 points. Osteoarthritis Cartilage. 2021;29(Suppl 1): s31–S33. doi:10.1016/j.joca.2021.02.054.

[19] Gossec L, Paternotte S, Maillefert JF, et al. The role of pain and functional impairment in the decision to recommend total joint replacement in hip and knee osteoarthritis: an international cross-sectional study of 1909 patients. Report of the OARSI-OMERACT Task Force on Total Joint Replacement. Osteoarthritis Cartilage. 2011;19(2):147–154. doi:10.1016/j.joca.2010.10.025.

[20] Katz JN, Winter AR, Hawker G. Measures of the appropriateness of elective orthopaedic joint and spine procedures. J Bone Joint Surg Am. 2017;99(4):e15. doi:10.2106/JBJS.16.00473.

[21] Huynh C, Puyraimond-Zemmour D, Maillefert JF, et al. Factors associated with the orthopaedic surgeons' decision to recommend total joint replacement in hip and knee osteoarthritis: an international cross-sectional study of 1095 patients. Osteoarthritis Cartilage. 2018;26(10):1311–1318. doi:10.1016/j.joca.2018.06.013.

[22] Jones G. Pain in OA: is cartilage loss a major contributor? Nat Rev Rheumatol. 2020;16(10):541–542. doi:10.1038/s41584-020-0484-3.

[23] Bacon K, LaValley MP, Jafarzadeh SR, et al. Does cartilage loss cause pain in osteoarthritis and if so, how much? Ann Rheum Dis. 2020;79(8):1105–1110. doi:10.1136/annrheumdis-2020-217363.

[24] Wu XD, Wu D, Huang W, et al. Relation between cartilage loss and pain in knee osteoarthritis. Ann Rheum Dis. 2022;81(7):e127. doi:10.1136/annrheumdis-2020-218433.

[25] Golightly YM, Allen KD, Caine DJ. A comprehensive review of the effectiveness of different exercise programs for patients with osteoarthritis. Phys Sportsmed. 2012;40(4):52–65. doi:10.3810/psm.2012.11.1988.

[26] Bennell KL, Egerton T, Martin J, et al. Effects of physical therapy on pain and function in patients with hip osteoarthritis: a randomized clinical trial. JAMA. 2014;311(19):1987–1997. doi:10.1001/jama.2014.4591.

[27] Wallis JA, Taylor NF. Pre-operative (non-surgical and non-pharmacological) for patients with hip or knee osteoarthritis awaiting joint replacement surgery-a systematic review and meta-analysis. Osteoarthritis Cartilage. 2011;19(12):1381–1395. doi:10.1016/j.joca.2011.09.001.

[28] Ageberg E, Link A, Roos EM. Feasibility of neuromuscular training in patients with severe hip or knee OA: the individualized goal-based NEMEX-TJR training program. BMC Musculoskelet Disord. 2010;11(1):126. doi:10.1186/1471-2474-11-126.

[29] Dahlberg LE, Dell'Isola A, Lohmander LS, et al. Improving osteoarthritis care by digital means-Effect of a digital self-management program after 24- or 48-weeks of treatment. PLoS One. 2020;15(3):e0229783. doi:10.1371/journal.pone.0229783.

[30] Fernandes L, Storheim K, Sandvik L, et al. Efficacy of patient education and supervised exercise vs patient education alone in patients with hip osteoarthritis: a single blind randomized clinical trial. Osteoarthritis Cartilage. 2010;18(10):1237–1243. doi:10.1016/j.joca.2010.05.015.

[31] Svege I, Nordsletten L, Fernandes L, et al. Exercise therapy may postpone total hip replacement surgery in patients with hip osteoarthritis: a long-term follow-up of a randomized trial. Ann Rheum Dis. 2015;74(1):164–169. doi:10.1136/annrheumdis-2013-203628.

[32] Hayashi K, Tokunaga S, Tsunoda T, et al. The response to pericapsular soft tissue and pelvic realignment therapy may be partially predicted by the relevant factors influencing the program's response of the candidates with hip osteoarthritis for joint replacement. Curr Med Res Opin. 2025;41(2):281–296. doi:10.1080/03007995.2025.2454508.

[33] Bannuru RR, Osani MC, Vaysbrot EE, et al. OARSI guidelines for the non-surgical management of knee, hip, and polyarticular osteoarthritis. Osteoarthritis Cartilage. 2019;27(11):1578–1589. doi:10.1016/j.joca.2019.06.011.

[34] Gibbs AJ, Wallis JA, Taylor NF, et al. Osteoarthritis management care pathways are complex and inefficient: a qualitative study of physiotherapist perspectives from specialised osteoarthritis services. Musculoskeletal Care. 2022;20(4):860–872. doi:10.1002/msc.1638.

[35] Takeuchi H. Gait- and postural-alignment-related prognostic factors for hip and knee osteoarthritis: toward the prevention of osteoarthritis progression. Phys Ther Res. 2019;22:31–37. doi:10.1298/ptr.R0003.

[36] Brekke AF, Holsgaard-Larsen A, Torfing T, et al. Increased anterior pelvic tilt in patients with acetabular retroversion compared to the general population: a radiographic and prevalence study. Radiography (Lond). 2022;28(2):400–406. doi:10.1016/j.radi.2021.10.003.

[37] Brekke AF, Overgaard S, Hróbjartsson A, et al. Non-surgical interventions for excessive anterior pelvic tilt in symptomatic and non-symptomatic adults: a systematic review. EFORT Open Rev. 2020;5(1):37–45. doi:10.1302/2058-5241.5.190017.

[38] Moreside J, Wong I, Rutherford D. Altered erector spinae activity and trunk motion occurs with moderate and severe unilateral hip OA. J Orthop Res. 2018;36(7):1826–1832. doi:10.1002/jor.23841.

[39] Hausser RA, Matias D. Treatments for leg length discrepancy, pelvic tilt, pelvic incidence-lumbar lordosis

mismatch, and walking difficulties. http://www.caring-medical.com/prolotherapy-news/leg-length-discrepancy-causing-hip-back-pain/. [accessed 3 September 2022].

[40] Kim C, Nevitt M, Guermazi A, et al. Leg length inequality and hip osteoarthritis in the multicenter osteoarthritis study and the osteoarthritis initiative. Arthritis Rheumatol. 2018;70(10):1572–1576. doi:10.1002/art.40537.

[41] Khamis S, Carmeli E. Relationship and significance of gait deviations associated with limb length discrepancy: a systemic review. Gait Posture. 2017;57:115–123. doi:10.1016/j.gaitpost.2017.05.028.

[42] Warren S. The myth of unequal leg length: the anatomy of functional leg length discrepancy. 2021. https://www.somaticmovementcenter.com/uneven-leg-length-the-myth-of-uneven-leg-length/ [accessed 23 May 2023].

[43] Schamberger W, Lane D, Fraser L, et al. Common presentations and diagnostic techniques. In: The Malalignment Syndrome. 2nd ed. London: Churchill Livingston Elsevier Ltd; 2013. p. 9–123.

[44] National Guideline Center (UK) Evidence review for preoperative rehabilitation: joint replacement (primary): hip, knee and shoulder, NICE Guideline No. 157. 2020. https://www.nice.org.uk/guidance/ng157/evidence/c-preoperative-rehabilitation-pdf-8771013040.

[45] Beaupre LA, Lier D, Davies DM, et al. The effect of a preoperative exercise and education program on functional recovery, health related quality of life, and health service utilization following primary total knee arthroplasty. J Rheumatol. 2004;31(6):1166–1173. https://www.jrheum.org/content/31/6/1166

[46] Berge DJ, Dolin SJ, Williams AC, et al. Pre-operative and post-operative effect of a pain management programme prior to total hip replacement: a randomized controlled trial. Pain. 2004;110(1–2):33–39. doi:10.1016/j.pain.2004.03.002.

[47] Crowe J, Henderson J. Pre-arthroplasty rehabilitation is effective in reducing hospital stay. Can J Occup Ther. 2003;70(2):88–96. doi:10.1177/000841740307000204.

[48] Doiron-Cadrin P, Kairy D, Vendittoli PA, et al. Feasibility and preliminary effects of a tele-prehabilitation program and an in-person prehabilitation program compared to usual care for total hip or knee arthroplasty candidates: a pilot randomized controlled trial. Disabil Rehabil. 2020;42(7):989–998. doi:10.1080/09638288.2018.1515992.

[49] Ferrara PE, Rabini A, Maggi L, et al. Effect of preoperative physiotherapy in patients with end-stage osteoarthritis undergoing hip arthroplasty. Clin Rehabil. 2008;22(10–11):977–986. doi:10.1177/0269215508094714.

[50] Gocen Z, Sen A, Unver B, et al. The effect of preoperative physiotherapy and education on the outcome of total hip replacement: a prospective randomized controlled trial. Clin Rehabil. 2004;18(4):353–358. doi:10.1191/0269215504cr758oa.

[51] Huang SW, Chen PH, Chou YH. Effects of a preoperative simplified home rehabilitation education program on length of stay of total knee arthroplasty patients. Orthop Traumatol Surg Res. 2012;98(3):259–264. doi:10.1016/j.otsr.2011.12.004.

[52] Vukomanovic A, Popovic Z, Djurovic A, et al. The effects of short-term preoperative physical therapy and education on early functional recovery of patients younger than 70 undergoing total hip arthroplasty. VSP. 2008;65(4):291–297. doi:10.2298/VSP0804291V.

[53] Bereford-Cooke C. Shiatsu: theory and practice. 2nd ed. Edinburgh: Elsevier Science Ltd; 2003.

[54] Long AF. The practitioners within the cross-European Shiatsu study. Their characteristics and an insight into their practice. University of Leeds; 2007. https://eprints.whiterose.ac.uk/42958/

[55] Harris PE, Pooley N. What do shiatsu practitioners treat? A nationwide survey. Complementary Ther Med. 1998;6(1):30–35. doi:10.1016/S0965-2299(98)80054-X.

[56] Suzukamo Y, Fukuhara S, Green J, et al. Validation testing of a three-component model of Short FORM-36 scores. J Clin Epidemiol. 2011;64(3):301–308. doi:10.1016/j.jclinepi.2010.04.017.

[57] Podsiadlo D, Richardson S. The Timed "Up and Go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39(2):142–148. doi:10.1111/j.1532-5415.1991.tb01616.x.

[58] Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. Ann Rheum Dis. 1957;16(4):494–502. doi:10.1136/ard.16.4.494.

[59] Peter WF, Jansen MJ, Bloo H, et al. KNGF guideline for physical therapy in patients with osteoarthritis of the hip and knee. Dutch J Phys Ther. 2010;120:S1–S24.

[60] Haskins R, Henderson JM, Bogduk N. Health professional consultation and use of conservative management strategies in patients with knee or hip osteoarthritis awaiting orthopaedic consultation. Aust J Prim Health. 2014;20(3):305–310. doi:10.1071/PY13064.

[61] Hayashi K, Tsunoda T. Effects of stabilizing the rear foot, realigning overpronation of the rear foot, and equalizing limb length for patients with hip osteoarthritis. Osteoarthritis Cartilage. 2024;32:S553–S555. doi:10.1016/j.joca.2024.02.823.

[62] Hayashi K, Tsunoda T. Effects of stabilizing the rear foot by tight fixation of proximal shoelaces for patients with hip osteoarthritis. Osteoarthritis Cartilage. 2025;33:S473–S475. https://www.oarsijournal.com/article/S1063-4584(25)00719-8/abstract doi:10.1016/j.joca.2025.02.694.