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Arthroplasty in patients with rare conditions

Total knee arthroplasty in multiple sclerosis

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ABSTRACT

We present a case report of total knee arthroplasty complicated by spasticity and contractures in a patient with multiple sclerosis (MS). Four previous case reports in the literature describe adverse outcomes after total knee arthroplasty in persons with MS secondary to severe spasticity. Preoperative, intraoperative, and postoperative considerations for persons with MS, which may help to improve functional outcomes, are discussed. Prospective research is needed among persons with MS to help determine the timing and selection of persons for arthroplasty and to minimize complications related to spasticity.

Introduction

Multiple sclerosis (MS) is a chronic, degenerative inflammatory disease of the central nervous system. It is estimated that 2.3 million people worldwide have MS with the highest prevalence rates reported in North America and Europe [1]. The etiology of MS is not fully understood, involving autoimmune mechanisms in genetically susceptible individuals [2]. The prevalence of arthritic comorbidity among persons with MS is still an evolving area of research and is estimated to be in the range of 16%-26% [3,4]. Although total knee arthroplasty (TKA) may lead to enhanced function for selected persons with MS, to date, the literature highlights only case reports with adverse outcomes and limited follow-up. Here, we present the 2-year follow up of a 75-year-old woman with primary progressive MS who received a right TKA for osteoarthritis 18 years after the initial onset of MS symptoms.

Case history

Informed consent was obtained for the case report. MS onset was at age 57 involving nonremitting right hand weakness and numbness followed by progressive symptoms of right spastic toe flexor posturing and foot drop. These symptoms occurred over the course of 12 months. She fulfilled diagnostic criteria for primary progressive MS [5] with periventricular brain T2 lesions on magnetic resonance imaging, positive oligoclonal bands in the cerebrospinal fluid, and disease progression for 1 year. She experienced a gradual decline in her mobility in the absence of relapsing symptoms over time. Fourteen years after MS onset, she progressed to needing a gait aid (cane or walker) intermittently for community mobility.

Fifteen years after MS onset, the patient experienced progressive right knee pain consistent with osteoarthritis. Over the course of 3 years, she failed conservative measures for pain relief, including intra-articular knee corticosteroid injections, acetaminophen and naproxen. She remained ambulatory with a single straight cane for at least 100 m but began to use a wheelchair largely for community mobility. The patient experienced a fall, which did not result in serious injury but did provoke a fear of future falls. The surgeon's notes detail the patient experiencing pain with weight-bearing during transfers. The patient elected to proceed with knee arthroplasty. Preoperative radiographs showed severe lateral and mild-to-moderate medial osteoarthritis of the right knee (Fig. 1).

Medical history included thyroid disease and depression. Preoperative lower extremity strength was grade 3 bilaterally for hip flexion and grade 4 for all other muscle groups. Tone was mildly increased in both lower limbs with preserved full range of motion. There was nonsustained clonus at both ankles. Preoperative medications were baclofen 10 mg/day and oxybutynin 5 mg/day.

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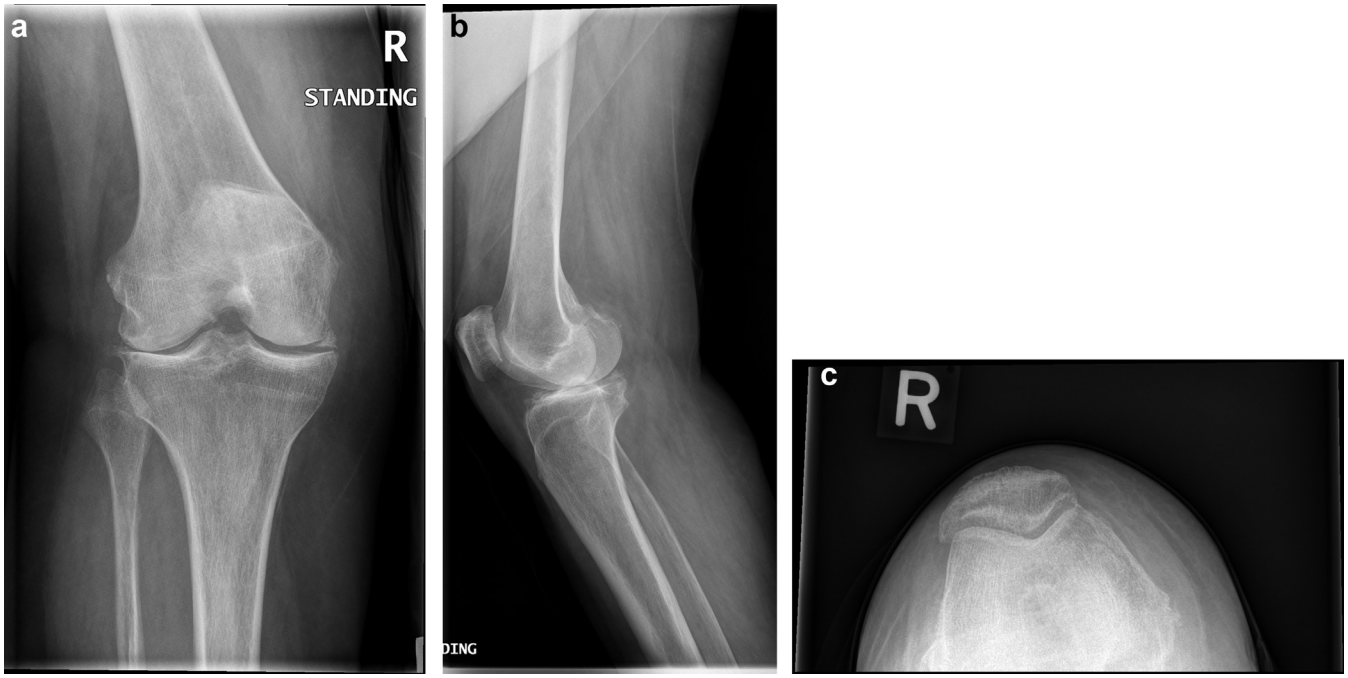

Figure 1. Preoperative (a) anteroposterior, (b) lateral, and (c) Merchant radiographs.

She received the right TKA 18 years after MS onset under a general anesthetic without administration of nerve blocks. Cefazolin was provided preoperatively. A standard midline approach with a medial parapatellar arthrotomy was used. Significant lateral compartment arthritis and contracture were evident during the surgical procedure. Components were sized, trialed, and cemented into place with Palacos R+G cement (Zimmer, Warsaw, IN). The components were from the Zimmer NexGen LPS total knee system (Zimmer, Warsaw, IN). These components provided good range of motion and soft tissue balancing at the conclusion of the surgery. Aside from the muscle contracture, no other problems were encountered intraoperatively. The bone and soft tissue quality was adequate. The articular capsule was of good quality and there was not any scar tissue noted. The patella was inspected intraoperatively. The articular cartilage was of good quality, and it tracked well after implantation of the components; thus, the decision was made to not resurface the patella. A tourniquet was used and no excessive bleeding was encountered. Excellent hemostasis was achieved at the end of the case.

Postoperatively, the patient developed a significant increase in her lower extremity spasticity and related pain. Postoperative imaging was negative for deep vein thrombosis, joint effusion, or other complications (Fig. 2). She received 4 doses of intravenous morphine 2-3 mg in the recovery room with gabapentin 200 mg followed by scheduled acetaminophen 650 mg every 4 hours, gabapentin 100 mg tid, celecoxib 100 mg bid, and sustained release hydromorphone 3 mg with senna bid postoperatively. Immediate release hydromorphone 1-4 mg was ordered prn and rarely used. Scheduled sustained release hydromorphone was discontinued on postoperative day 7. She assumed a crouch gait on trial of weight bearing.

On postoperative day 19, the patient was transferred to inpatient rehabilitation after developing severe lower extremity tone with bilateral knee contractures. She received range of motion exercises and gait training twice daily. Thirty days postoperative, botulinum (300 IU) was administered into the right medial and lateral hamstrings. She was discharged to the community 75 days postoperatively after achieving an independent gait with a 4-wheeled walker for 40 m and near-full passive range of motion of −15° to 120° of flexion at both knees. Discharge medications were baclofen 10 mg qam and 20 mg qhs. Higher daytime doses of antispasticity medications were not tolerated because of a side effect of generalized weakness.

After discharge to the community, despite reported compliance with a home exercise program, the right knee flexion contracture worsened to 35°. She received repeat botulinum injections of 300 IU divided between the right medial hamstrings and hip adductors at 4 and 7 months postoperatively with minimal improvement. Ambulation status continued to decline over the next year such that walking became limited to 5 m with a walker and an assistant. The patient expressed frustration as she had hoped to regain ambulatory status without aids after the arthroplasty. She began more intense outpatient physiotherapies involving use of a standing frame, assisted platform walking, and range-of-motion exercises. She also accessed services through a community exercise group, which provided specialized support for persons with disability. At 24 months postoperatively, she had improved her walking distance back to short household distances independently with a 4-wheeled walker.

Discussion

In our case, sustained spasticity postoperatively was largely refractory to medical management. Spasticity is part of the upper motor neuron syndrome and is common among persons with MS [6]. Previous MS case reports have also described severe spasticity resulting in adverse short-term outcomes after TKA (Table 1). In our case, at 2 years after arthroplasty and 20 years after the onset of progressive MS, the patient had maintained her ambulatory status with a 4-wheeled walker for household distances. The patient however was not satisfied with her protracted course of rehabilitation or her functional outcome. Finding the optimal timing of knee arthroplasty for persons with MS and identifying additional factors in preoperative, intraoperative, and postoperative TKA care among persons with MS may help to optimize future outcomes.

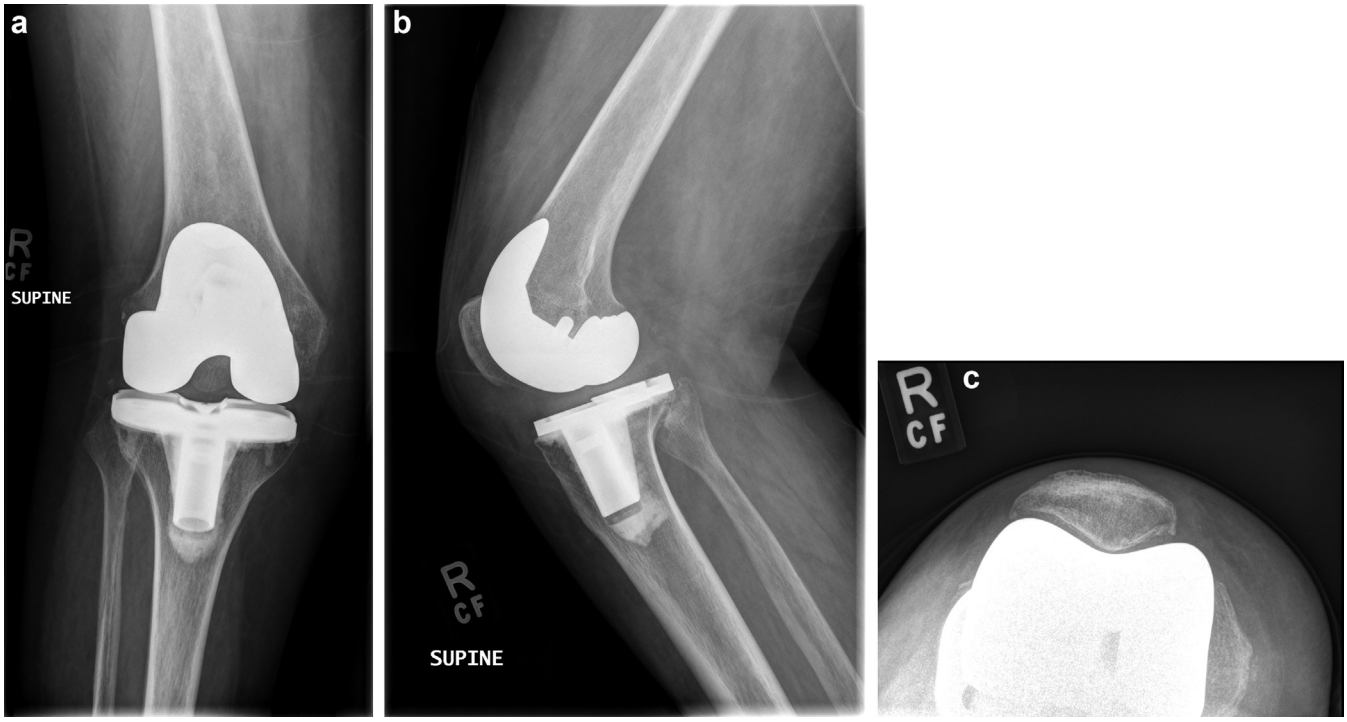

Figure 2. Postoperative (a) anteroposterior, (b) lateral, and (c) Merchant radiographs.

The timing and selection of TKA for persons with MS: MS course, disability progression, and MS-specific treatment considerations

The majority of persons with MS begin with a relapsing-remitting MS course (RRMS) where new or worsening neurologic symptoms appear and then remit or improve within days, weeks, or several months [10]. As many as 50% presenting with RRMS may remain ambulatory without the use of cane 25 years after MS onset [11], therefore, the majority of persons with RRMS may expect to remain independently ambulatory for a significant portion of their adult life (Table 2). However, over time, most persons with RRMS experience a transition to a secondary progressive MS course where disability progression continues largely in the absence of ongoing relapse. Approximately 10% of persons with MS present at onset with a primary progressive course, experiencing disability progression over time in the absence of relapses. A primary progressive MS course at onset carries a worse prognosis for earlier disability progression compared to RRMS. However, as more advanced disability milestones are achieved, rates of further disability progression become more comparable (Table 2).

Although MS is an unpredictable disease, knowledge of the patient's individual MS disease course and mobility decline over time may help to inform the selection, timing, and expectations for TKA. The goals of TKA may differ, depending on the stage and rate of

Table 1
Adverse short-term outcomes after TKA.

Case	Demographic	Years diagnosed with MS	Complications	Postoperative aid	Postoperative antispasmodic	Sequelae
1 [7]	59-year-old woman	10	Recurrent knee dislocations	Mobile-bearing knee prostheses	Tizanidine	Presented to the emergency department followed with revision procedure (replacement with a thicker polyethylene insert). Loss of extension of the knee and residual hamstring spasms. A second nocturnal spasm resulted in a second dislocation with open reduction followed by cylinder cast.
2 [8]	70-year-old man	46	Hamstring spasticity	Knee brace and walking stick	Baclofen	Progressive anterior knee pain ×2 years with elective surgical release of gracilis and later, biceps femoris tendon. Ultimately pain free with 4/5 quadraceps power, mobilizing with knee brace and walking stick
3 [8]	74-year-old man	~50	Hamstring spasticity and dislocation of rotating tibial insert	Donjoy brace	Baclofen	Open reduction of component was required and hamstrings released. Unhappy with result and being treated for depression.
4 [9]	64-year-old woman	30	Hamstring spasticity and posterior knee dislocation 1 month postoperatively	Extension splint	Baclofen	Closed reduction of dislocated prosthesis unsuccessful, therefore subsequent revision of TKA required with prophylactic botulinum injections to right hamstring

Table 2
Disability progression[a] and survival in relapsing-remitting MS vs primary progressive MS.

Outcomes	Relapsing-remitting MS	Primary progressive MS
Estimated median time (y) from MS onset to required cane use [12-14]	23-30	7-13
Estimated median time (y) from cane use to wheelchair level mobility [12]	3	4
Estimated median age at MS onset of first symptoms [13]	29	40
Estimated median survival (y) from MS onset [15,16]	43-50	26-33

[a] Although the median reported time for disability milestones and survival may be helpful in understanding outcomes, it is important to remember that MS is a highly variable disease.

disability progression. In our case, the patient had primary progressive MS and began using mobility devices several years before her TKA and before clearly documented knee pain. Given our patient's scenario, continued use of mobility aids would be anticipated after TKA despite the fact that our patient had greater expectations for improvement. Arthroplasty may have helped to prolong her independence with transfers and walking function with aids by alleviating pain, allowing for longer term continued activity and preventing deconditioning weakness.

In the future, more objective documentation of mobility decline over time before TKA may help to better inform the prognosis and expectations after arthroplasty. Objective assessment of mobility impairment may be achieved with the Timed 25-Foot Walk test [17,18] performed serially over time. A 20% change in the patient's fastest walking speed is considered clinically relevant. A careful clinical history may differentiate a decline in mobility related to MS symptoms from restrictions secondary to arthritic comorbidity.

In addition to the rate of mobility decline, relapse history may impact TKA decision-making for those patients with RRMS. Pulse steroids, which may be used in the management of severe MS relapses, could impact bone health and risk of joint infection and delay wound healing. A period of severe fatigue and deconditioning may also follow a relapse. Most patients with recurring relapses would be considered for MS disease-modifying treatment or for a switch in their treatment regime if already on treatment. True MS relapses are not to be confused with pseudorelapses where a temporary worsening of previous or existing neurologic symptoms occurs under the influence of a stressor, including the stress of surgery. There is currently little evidence that surgery increases the risk of true MS relapses. A detailed preoperative and postoperative neurologic history and examination may help to differentiate true relapses from pseudorelapses after surgery.

Disease-modifying therapies for patients with RRMS have reduced the relative risk of true relapses by as much as 30%-70% in clinical trials. The first-line injectable disease-modifying therapies (glatiramer acetate and interferons) may be safely continued through the perioperative period as long-term data do not support an increased risk of infection with their use. Long-term data on risk of infection and practice patterns for the newer oral first-line therapies (dimethyl fumarate and teriflunomide) through the perioperative period are not yet available. For treatments largely considered second line (natalizumab, fingolimod, and alemtuzumab), the risk of infection is higher than that with the first-line treatments. While no guidelines exist in MS for stopping MS treatment before surgery, second-line treatments as well as newer and emerging first-line treatments have shown more potent effects on the immune system. The consequences of stopping therapies could result in rebound MS disease activity for some patients. An individualized assessment of risk, disability progression, relapses, and response to treatment history may help to inform the optimal timing and selection of appropriate patients for TKA.

Preoperative planning once a decision has been made for TKA

Milder fluctuating or more severe paroxysmal MS symptoms may occur independent of MS relapses and should be optimally managed before surgery, especially spasticity. In their report of 2 cases with refractory postoperative spasticity, Shannon et al. [8] proposed that a preoperative increase in oral antispasticity medication might reduce the risk for severe postoperative spasticity. Although this may be a reasonable approach for selected patients, intolerable side effects often do not allow sufficient dose titration to control the spasticity. This was the case with our patient. Poor patient satisfaction with available antispasticity pharmacological options is common in MS [19].

Because spasticity may be worsened under any stressors, screening and treating stressors may have a marked impact on the spasticity. Some treatable common stressors include urinary tract infection (UTI), urinary retention, constipation, uncontrolled pain, and severe anxiety. The usual symptoms of UTI may not be readily apparent in persons with MS. Prophylactic treatment for UTI does not decrease the risk of joint infection in general populations [20], but routine screening or prophylactic treatment of UTI in MS patients preoperatively may warrant consideration to reduce postoperative complications related to both spasticity and infection.

The focal administration of high-dose botulinum into the hip adductors has been shown to be effective in reducing lower extremity spasticity in MS [21], although its effect on function is less clear. Botulinum could be considered preoperatively in high-risk patients with increased baseline lower extremity spasticity. Appropriate planning would be required to target specific muscles. Peak effects from botulinum occur within weeks [22]. Approximately 1/3 of patients may experience temporary focal weakness which may necessitate additional measures to prevent falls [23]. A preoperative approach with botulinum warrants further study, especially given the limited efficacy and tolerability of oral pharmacotherapy options [24].

Intrathecal baclofen is another option highly effective in the treatment of spasticity and underused in MS care [25]. There may be a role for intrathecal baclofen in ambulatory patients with severe baseline spasticity. The intrathecal administration offers fine dose titration without systemic side effects [26]. However, consultation and coordination with specialized services would be required.

A preoperative rehabilitation conditioning program may help to reduce spasticity and offer other advantages. Although there is low-level evidence that physical activity and other modality interventions reduce spasticity [27], patients may experience improved MS symptoms and improved physical functioning with physical activity programs [28]. Cognitive impairment, mood disorder, and potential barriers for compliance with a program may be overcome with additional supports in place.

Intraoperative care and postoperative planning

Our patient had significant lateral compartment contracture at the time of her surgery. Because the future stability of the knee is also a concern, it would seem reasonable to avoid tendon releases if possible. In our patient, sufficient range of motion was achieved without tendon releases; however, she later developed severe contractures. Possibly targeting the lateral hamstrings with

botulinum intraoperatively or earlier in the postoperative period may have prevented the contracture formation.

To ensure stability of the TKA, Rao et al. [7] recommended in their case report a fixed-bearing posterior-stabilized prosthesis. A more constrained prosthesis in patients with severe spasticity may reduce the risk of dislocation. Although this was not needed for our patient, a previous dislocation was reported by Bron et al. [9].

Minimizing postoperative complications and maximizing pain control using a multi-modal approach may reduce postoperative spasticity. Shannon et al. [8] proposed a prolonged period of regional anesthesia postoperatively. In a large Italian study of childbirth among women with MS, epidural anesthetic was not associated with an increased risk of subsequent relapses or disability progression [29]. If no other contraindications exist, patients should be offered spinal analgesia over general anesthetic. Continuous peripheral nerve blocks, perineural local anesthetic infusion, systemic opioid and nonopioid pain medications (including medications for neuropathic pain) may all be considered in combination for early and aggressive pain control. A regular comprehensive bowel care regime is also important because patients with MS are prone to neurogenic bowel [30].

While the recommended duration of treatment for thromboembolism prophylaxis is 10-35 days for general TKA populations [31,32], as patients with MS may be slower to mobilize, we suggest that longer durations be considered. Although continuous passive motion devices may not be routine care in general orthopaedic TKA practices [33], these devices may have a role for patients with MS at higher risk for complications related to immobility.

Given the barriers to physical activity that persons with MS experience [34] and the progressive nature of the disease, persons with MS may benefit from prolonged and individualized support from physical therapists to achieve and maintain their maximum functional potential after TKA. While there is no evidence that extended outpatient programs supported by a physical therapist improve long-term outcomes in the general practice of TKA [35], this may not be the case for persons with MS. Our patient experienced a functional decline and increase in her knee contracture after discharge from inpatient rehabilitation. This occurred despite reported compliance with a home program and limited outpatient physical therapy follow-up. She improved back to her baseline coincident with intensified outpatient therapies achieved through a combination of specialized community activity groups for persons with neurologic disability and more one-on-one outpatient physical therapy. Persons with other neurologic disability discharged from structured inpatient rehabilitation programs experience deconditioning and functional decline after discharge to the community [36]. There may be a case for more routine prolonged and professionally supported rehabilitation care for persons with MS undergoing TKA.

Current controversies and future considerations

The optimal patient selection criteria and timing of TKA for persons with MS remains unclear. Spasticity appears to be a significant complicating factor and optimal management is challenging. We have proposed some of the factors that might assist with decision-making and some considerations regarding spasticity management. Aggressive postoperative pain control; posterior-stabilized prostheses; early consideration for botulinum treatment; and prolonged, intensified rehabilitation services may help to mitigate complications related to spasticity. Oral pharmacotherapy may have limited efficacy and tolerability in the management of severe spasticity in MS, and new approaches are needed. In the future, monitoring of both short-term and long-term outcomes, including patient-reported outcomes, after TKA in MS could help to guide practice.

Summary

The person's individual disease course, their treatment history, the natural history of MS, and whether the goals associated with TKA may be reasonably achieved warrant consideration when planning TKA for persons with MS. Severe spasticity refractory to medical management is reported after TKA and may result in complications. Our patient with progressive MS undergoing TKA maintained ambulatory status with a walker despite initial challenges with severe spasticity. However, she was not satisfied, as she did not achieve her goal of walking without aids. Monitoring future care practices and outcomes related to TKA in MS may help to guide optimal management.

KEY POINTS

- Although MS is a progressive disease of the central nervous system, patients may maintain ambulatory function for a significant duration of their adult lives, and therefore, optimal management of osteoarthritis limiting function is warranted.
- Spasticity in persons with multiple sclerosis may lead to complications after TKA including late contractures and dislocations.
- More work is needed to determine how to optimally prevent complications related to severe spasticity after TKA. Early and prolonged intensified rehabilitation programs, more aggressive use of early botulinum, and intrathecal baclofen may warrant further consideration.
- Although MS is a highly variable and unpredictable disease, knowledge of the patient's individual MS disease course and mobility decline over time may help to better inform the selection and timing for TKA.
- Efforts should be made to align the expectations of people with MS undergoing arthroplasty with the possible and likely outcomes related to their individual situation.

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