

## RESEARCH ARTICLE

# Progressive Late-Onset Genu Recurvatum Post-Total Knee Arthroplasty: Insights from a Spinal Stenosis-Related Case Series

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## Abstract

**Objectives:** Knee osteoarthritis is common among older individuals, necessitating Total Knee Arthroplasty (TKA) for end-stage cases. The aging population has increased TKA demand, leading to a rise in revision surgeries. Genu recurvatum, a rare complication, often requires surgical intervention, with late-onset cases linked to neuromuscular conditions. This case series focuses on the infrequent occurrence of late-onset genu recurvatum resulting from spinal stenosis in patients without other predisposing conditions.

**Methods:** A retrospective case series of 10 patients (11 knees) referred between February 2016 and August 2020 due to late recurvatum instability. Exclusion criteria encompassed neuromuscular diseases other than spinal stenosis, prosthetic joint infection, and pre-existing recurvatum deformity. Data, including demographics, medical history, imaging findings, and surgical details, were collected retrospectively. Patient performance was assessed using the Knee Society Score (KSS) at specified postoperative intervals.

**Results** The study cohort, exhibiting hyperextension ranging from 11 to 30 degrees, underwent successful revision surgery using rotating hinge knee (RHK) implants after failed conservative measures. Follow-up assessments at 6, 18, and 24 months showed no recurrence of genu recurvatum.

**Conclusion:** Late-onset genu recurvatum poses a challenge, necessitating surgical intervention. Identifying predisposing factors is crucial, with spinal stenosis emerging as a rare cause. The use of posterior stabilized (PS) implants in primary surgery aligns with higher revision rates, possibly linked to PCL removal. Limited literature explores the spinal-genu recurvatum relationship. A stepwise screening protocol is proposed for high-risk patients, emphasizing history, physical examination, and imaging. Strategic considerations include lower constraining, a tighter extension gap, and potential use of Hinge implants.

**Level of evidence:** V

**Keywords:** Case series, Genu recurvatum, Spinal stenosis, Total knee arthroplasty

## Introduction

Osteoarthritis is a prevalent condition among older adults, affecting approximately 13% of women and 10% of men aged 60 and over, with a predilection for knee joints.<sup>1</sup> Total knee arthroplasty (TKA) stands as

the gold standard for managing pain and enhancing function in end-stage knee osteoarthritis.<sup>2</sup> As the aging population continues to grow, there is a concomitant rise in demand for TKA, leading to an increased incidence of

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cases necessitating revision surgery. Common causes of early revisions (within two years after the primary TKA) include infection and knee instability, whereas aseptic loosening emerges as a prominent cause in late revision surgeries.<sup>3-5</sup> Knee instability accounts for 10%-22% of all revision surgeries.

Tibiofemoral instability manifests in three distinct patterns: flexion instability, genu recurvatum, and extension instability.<sup>6</sup> Genu recurvatum, also recognized as hyperextension instability, represents the rarest form, with a prevalence ranging from 0.5% to 1%.<sup>7</sup> A noteworthy subset of genu recurvatum cases after TKA necessitates revision surgeries. While early-onset genu recurvatum typically occurs within six months after TKA and is often attributed to technical errors during surgery, late-onset recurvatum is more commonly associated with neuromuscular conditions, such as paralysis, poliomyelitis, quadriceps weakness, and preoperative genu valgus deformities.<sup>8,9</sup>

In this case series, we draw attention to the rare occurrence of late-onset genu recurvatum caused by spinal stenosis in patients without other predisposing conditions. Within this context, we presented 10 cases wherein individuals with spinal stenosis developed genu recurvatum following primary TKA and subsequently underwent successful revision surgery employing a rotating hinge knee (RHK) implant.

### Case Presentation

Between February 2016 and August 2020, 10 patients (5 males and 5 females) with a mean age of  $64.54 \pm 4.36$  years underwent TKA revision surgery at Imam Hossein Hospital, affiliated with Shahid Beheshti University of Medical Sciences, Tehran, Iran, due to progressive recurvatum instability ranging from 11-30 degrees manifesting within  $14.9 \pm 4.36$  months of primary TKA [Figure 1]. Upon initial examination, these patients exhibited quadriceps muscle weakness at grade 4, according to the Medical Research Council Scale, with the ability to overcome gravity [Figure 2].<sup>10</sup> These patients had no history of neurological diseases, such as poliomyelitis and stroke. Nevertheless, all cases had a history of spinal stenosis involving L2, L3, and L4 segments, impacting nerve roots innervating the quadriceps femoris, with six patients opting for spinal decompression surgery. The remaining four cases initially underwent TKA due to severe knee pain [Figure 3].

There was no evidence of component loosening in radiographic assessments. Laboratory tests, including erythrocyte sedimentation rate, C-reactive protein, and complete blood count, demonstrated no signs of infection. Comprehensive physical examination and Beighton score calculations ruled out generalized ligamentous laxity in these patients.<sup>11</sup> Subsequently, a hinged knee brace was utilized for all patients for four weeks, set to lock at 0 degrees of extension, to assess walking quality and ensure no deterioration in instability. Following re-evaluation after four weeks, with patients reporting satisfaction and absence of giving way, revision surgery was performed using the RHK prosthesis.



Figure 1. Pre-revision knee plain radiograph Progressive late-onset recurvatum instability started several months following TKA



Figure 2. Genu recurvatum associated with weakened quadriceps muscle due to spinal stenosis



Figure 3. Magnetic resonance imaging study of the patient's spinal stenosis Note the compression of the L4 root, resulting in quadriceps muscle weakness

**Surgical technique considerations**

In revision surgeries, apart from adhering to general considerations for TKA revision surgeries, two specific points are crucial in these patients. Firstly, considering the quadriceps weakness, it is essential to employ an approach that minimizes injury to the extensor mechanism. Therefore, we utilized the subvastus approach for prostheses access in these patients. Another critical step involves the technique of

**Postoperative follow-up**

Follow-up assessments with a mean score of  $33.6 \pm 5.2$  months post-revision revealed no recurrence of genu recurvatum. The patients' function illustrated a significant

component removal. Given the absence of loosening and the high probability of bone loss, we employed a fine osteotome or oscillating saw to delicately separate the component-cement interface from the anterior distal femur, as well as the medial and lateral plateaus of the tibia. To optimize exposure, we followed a specific sequence for component removal: initiating with the tibial liner, followed by the femoral component, and ultimately, the tibial component [Figure 4]. improvement compared to pre-revision, with the average Knee Society Score increasing from 53.1 to 70.7. The collected patient data is organized individually for each patient in [Table 1].



Figure 4. Post-revision anteroposterior and lateral X-rays Note the rotatory hinged design aimed at preventing hyperextension

Table 1. Summary of patient data

Patient Number	1	2	3	4	5	6	7	8	9	10
Age	62	64	67	70	57	66	58	69	60	71
Gender	Male	Female	Male	Female	Male	Male	Female	Female	Female	Male
PMH	DM <sup>a</sup> HTN <sup>b</sup>	-	DM	HLP <sup>c</sup>	-	-	HTN	-	DM HTN HLP	DM
BMI	33	34	31	30	32	29	28	31	29	30
Pre-revision recurvatum <sup>o</sup>	18	21	27	14	20	27	11	30	23	17
Preoperative KSS <sup>d</sup>	55	48	44	63	53	32	66	51	58	61
Postoperative KSS	73	59	63	81	71	60	76	70	72	82

a Diabetes Mellitus

b Hypertension

c Hyperlipidemia

d Knee Society Score

## Discussion

Late-onset genu recurvatum after primary TKA is a rare yet challenging complication, often necessitating surgical intervention.<sup>6</sup> The identification of preoperative predisposing factors is crucial to the development of arthritis, on mitigating the risk of late-onset genu recurvatum after TKA.<sup>7-9</sup> In their study, Mortazavi et al. (2020) reported the case of four patients experiencing late-onset post-TKA genu recurvatum due to generalized ligament laxity. In contrast to our cohort, none of these patients exhibited extensor mechanism weakness, and while conservative treatment proved effective for one patient, the remaining three underwent revision surgery. Regarding the adequate strength of the extensor mechanism and the tibia liner wearing, the problem was resolved by substituting the liner with a thicker one and tightening the extension gap.<sup>12</sup>

Nevertheless, studies addressing genu recurvatum due to spinal stenosis are scarce and mostly confined to case reports or case series. In 1993, Moorehead et al. reported a unique case involving a patient presenting with lower limb pain, genu recurvatum, and extensor mechanism weakness. After thorough investigations, the etiology was identified as cervical myelopathy due to discopathy. This case differed from the patients presented in our study since the genu recurvatum, in this case, manifested in the native joint, not post-TKA. Their treatment strategy involved addressing the cervical discopathy and implementing ankle-foot orthosis, resulting in the patient's recovery.<sup>13</sup>

In the same context, Shah et al. (2016) reported the case of a 77-year-old patient who, six months post-primary TKA, developed lower limb pain, recurvatum instability, and bladder dysfunction. The investigation revealed myelopathy caused by thoracic meningioma. Following spinal tumor resection, the patient required revision due to ligament laxity and posterior capsule laxity, addressed through the utilization of the RHK prosthesis.<sup>14</sup> Regarding the complexities of managing this instability, a stepwise screening protocol is proposed to prevent post-TKA genu recurvatum.<sup>15</sup> A thorough preoperative assessment of all TKA candidates, particularly those aged 60 and over, is crucial for symptoms indicative of spinal stenosis, such as low back pain, radiculopathy, paresthesia, and muscle weakness.<sup>16</sup> Suspicious symptoms should be investigated through lumbar magnetic resonance imaging.

Consensus among knee and spine surgeons underscores that in cases of concurrent severe spinal stenosis and advanced knee arthrosis, excluding specific deformities, prioritizing spinal surgery is generally agreed upon.<sup>17</sup> It is imperative to note that neuropathy may persist even after spinal decompression; therefore, post-spine surgery, ongoing assessment of muscle strength is vital.<sup>18</sup> In cases of suspected neuropathy, electrophysiological tests are recommended. Patients with a history of spinal stenosis who present neurogenic claudication merit special attention. If

screening protocols for high-risk patients. Previous studies have implicated the effect of conditions, such as poliomyelitis, quadriceps weakness, and rheumatoid

such patients exhibit neurogenic claudication, dynamic electrophysiological tests can significantly assist in diagnosis and determine the treatment strategy.<sup>19</sup> A tighter extension gap in primary TKA is recommended to mitigate this risk. In addition, the use of the RHK implant in primary arthroplasty may be considered in cases with severe quadriceps weakness to prevent postoperative genu recurvatum and revision surgery.<sup>20</sup>

## Conclusion

Comprehensive preoperative assessment for quadriceps muscle weakness attributed to spinal stenosis is crucial for patients undergoing primary TKA. It is imperative to address spinal stenosis through appropriate treatment modalities before TKA. Following the successful treatment of spinal stenosis, a strategic approach involves considering minimized extension gaps and may be appropriate for minor extensor mechanism weakness. For cases where more severe quadriceps muscle weakness persists after spinal stenosis decompression, the utilization of RHK prostheses can emerge as a primary option. Such considerations contribute to a more individualized and effective management strategy in TKA candidates with concurrent spinal stenosis and quadriceps weakness.

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