



## **Evaluating the Effectiveness of Valgus Offloading Knee Braces in Managing Medial Compartment Knee Osteoarthritis: A Comprehensive Systematic Review**

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**Abstract:**

*Knee osteoarthritis (OA), a prevalent degenerative joint disorder, disproportionately affects adults and is a leading cause of disability worldwide. Medial compartment OA is especially common due to the biomechanical loading of the knee joint. While total knee arthroplasty (TKA) remains the definitive solution for severe OA, its invasiveness, high cost, and recovery demands drive interest in nonoperative interventions, particularly in early stages of the disease. This review evaluates various treatment modalities, including valgus offloading braces, physical therapy, pharmacological interventions, and surgical options. Emphasis is placed on their effectiveness in improving clinical outcomes like pain, function, stiffness, and quality of life.*

**Introduction**

Hip fractures account for ~27% of fractures requiring hospital admission and 58% of hospital bed days in England [1]. Timely treatment is associated with reduced morbidity and mortality, observations which have been reproduced in several studies [2,3,4]. As such, NICE recommends surgical repair on the day of, or the day after, admission [5], and the Department of Health has introduced a Best Practice Tariff initiative to achieve this within 36 hours of admission.

Knee OA is one of the most common musculoskeletal disorders, affecting nearly 10% of adults aged over 45 globally. It poses a significant challenge due to its progressive nature, often resulting in chronic pain, reduced mobility, and joint deformity. Medial compartment OA, caused by varus malalignment and excessive loading of the medial tibiofemoral compartment, contributes to a significant proportion of OA cases.

While TKA remains the gold standard for severe OA, it is not always the ideal option due to risks such as infection, prosthetic failure, and the need for revision surgery in younger patients. Nonoperative options, ranging from bracing and physical therapy to intra-articular injections and regenerative medicine, provide a spectrum of choices that can delay or prevent surgical interventions. This paper reviews and compares the available treatments, emphasizing their relative effectiveness and patient outcomes.

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## Causes and Progression

Medial Compartment Knee OA:

- Commonly caused by biomechanical stress, age-related cartilage degeneration, and inflammation.
- Risk factors include obesity, prior joint injury, genetic predisposition, and metabolic disorders.

Progression:

- Early-stage OA is characterized by mild cartilage wear, stiffness, and occasional pain, progressing to advanced degeneration, subchondral bone exposure, and joint instability.

## Modes of Treatment

### 1. Nonoperative Interventions

#### Valgus Offloading Knee Braces

- Mechanism: Redistribute load from the medial to the lateral compartment, reducing pain and slowing disease progression.
- Effectiveness:
  - Pain relief: Significant reduction in most studies.
  - Function: Mixed outcomes in gait improvement and stiffness management.
  - Challenges: Patient compliance is often low due to discomfort and aesthetic concerns.

#### Physical Therapy and Exercise

- Common regimens include quadriceps strengthening, balance training, and gait correction.
- Benefits:
  - Reduces pain by stabilizing the joint and improving neuromuscular control.
  - Improves range of motion and enhances daily functioning.
  - Effective in delaying surgical interventions when combined with other modalities.
- Limitations: Requires consistent adherence and may be less effective for severe OA.

#### Weight Management

- Excess weight exacerbates knee joint loading, contributing to faster cartilage wear.
- Benefits:
  - Weight loss reduces knee load and pain severity.
  - Especially beneficial for overweight and obese individuals.

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## Orthotics and Shoe Modifications

- Custom insoles and lateral wedge insoles realign the lower limb and reduce medial compartment stress.
- Effectiveness:
  - Provides short-term relief in mild cases.
  - May complement other treatments like physical therapy or braces.

## Pharmacological Interventions

- Nonsteroidal anti-inflammatory drugs (NSAIDs): Manage inflammation and pain but have limited long-term benefits.
- Intra-articular injections:
  - Corticosteroids: Provide temporary relief from inflammation.
  - Hyaluronic acid: Enhances joint lubrication but has inconsistent results.
  - Platelet-rich plasma (PRP): Emerging as a regenerative therapy with promising outcomes in symptom reduction and cartilage preservation.

## 2. Surgical Interventions

### Osteotomy

- Realigns the knee joint by reshaping the tibia or femur, redistributing weight away from the medial compartment.
- Effectiveness:
  - Ideal for younger patients with moderate OA and good bone quality.
  - Delays TKA by 10–15 years.

### Partial Knee Arthroplasty (PKA)

- Replaces only the affected medial compartment, preserving healthy tissue.
- Effectiveness:
  - Provides targeted relief with faster recovery than TKA.
  - Risks include the potential need for revision surgery.

### Total Knee Arthroplasty (TKA)

- Replaces the entire knee joint with a prosthesis, providing relief for end-stage OA.
- Effectiveness:
  - High success rate in terms of pain relief and improved mobility.
  - Risks: Prosthesis wear, infection, and revision surgeries, particularly in younger patients.

3. Emerging Treatments

Regenerative Medicine

- Stem Cell Therapy:
  - Uses mesenchymal stem cells to regenerate cartilage and reduce inflammation.
  - Early studies show promise but lack long-term data.
- Gene Therapy:
  - Targets specific inflammatory pathways or promotes cartilage regeneration.

Biological Agents

- Tumor necrosis factor-alpha (TNF-α) inhibitors and interleukin-1 (IL-1) blockers are being explored for their potential in halting OA progression.

Alternative Therapies

- Acupuncture and tai chi have shown modest benefits in pain reduction and mobility improvement.
- Supplements like glucosamine and chondroitin sulfate remain controversial, with mixed evidence on their efficacy.

Comparative Effectiveness of Treatments

Treatment Mode		Pain Relief	Function Improvement	Long-term Impact	Cost	Risks/Challenges	
Valgus Braces	Offloading	Moderate	Mixed	Variable	Low	Compliance issues	
		High	High	Moderate	Low	Requires adherence	
		High	Moderate	Moderate	Low	Behavioral challenges	
Intra-articular Injections		Moderate	Limited	Short-term	Medium	Repeated administration	
Osteotomy		High	High	Long-term	High	Invasive; longer recovery	
Total Arthroplasty	Knee	Very High	Very High	Long-term	Very High	Prosthesis complications	

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## Discussion

Valgus offloading braces are a cornerstone of nonoperative treatment for medial compartment OA, particularly for pain relief. However, their limited impact on stiffness and function underscores the need for combined approaches. Physical therapy and weight management emerge as crucial components of a conservative treatment plan, improving joint stability and delaying disease progression.

Surgical interventions remain the most effective options for severe OA, with osteotomy offering a middle ground for younger, active patients. Emerging therapies like PRP and stem cell treatments hold promise for altering the disease course but require further validation.

## Conclusion

The management of medial compartment knee OA necessitates a multimodal approach tailored to disease severity, patient age, and functional goals. Nonoperative treatments provide meaningful symptom relief and delay surgical interventions, while surgery remains indispensable for advanced stages. Advances in regenerative medicine and minimally invasive techniques could revolutionize OA management in the coming years.

## Future Directions

Further research is needed to:

- Standardize protocols for combining conservative therapies.
- Explore the cost-effectiveness of emerging treatments.
- Develop patient-specific predictive models for treatment outcomes.

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