

Mechanical devices in Knee OA: Unloader braces & insoles

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Abstract

Mechanical devices in Knee OA have always been a popular option with the general population & the Orthopaedic fraternity, with little in terms of evidence based recommendations guiding their usage. There is a wide variety of braces available in the market, ranging from soft sleeves to the hi-tech unloading ones & it does become confusing at times, for both the patient & the practitioner on which one to pick at what stage of knee arthritis. This narrative review compiles the recent evidence available in the literature, especially some national guidelines that have been recently updated on these mechanical devices, along with a brief on their mechanism of action.

Keywords: knee arthritis, unloader brace, insoles, knee replacement, joint preservation, exercise, weight loss

Introduction

Knee osteoarthritis (OA), in the initial stages is confined to one compartment, typically the medial compartment in the Asian population due to the constitutional varus alignment of the lower limb [1,2]. A very popular surgical intervention, namely High Tibial Osteotomy (HTO), is based on this key premise that, if the alignment of the lower limb is so altered, as to shift load from the more diseased cartilage zone to a less diseased cartilage zone, it will result in reduction of pain & prolongation of the life of the native joint [3]. The very same principle is utilized by some mechanical devices like valgus unloading braces (or varus unloading ones for lateral gonarthrosis), in the initial stages of disease to give pain relief in initial stages of knee OA [ref]. The role of insoles has been less well established & they were not recommended by most key Orthopaedic society guidelines [4]. This narrative review will explore the use of these mechanical devices for knee pain due to OA & their current place in medical literature & treatment armamentarium of the modern Orthopaedic Surgeon.

The science behind Unloading the knee

The medial compartment of the knee is at a

mechanical disadvantage even in knees that have a valgus alignment [5]. This is due to the fact that during normal gait, except for a brief phase of valgus moment after initial contact, the knee is subject to varus moment throughout the stance phase [6]. In people with medial compartment knee arthritis, due to the reduction in the medial tibiofemoral joint space, the joint goes into a mechanical varus, that further accentuates this varus moment in such a patient population [6]. Valgus braces oppose this varus moment & reduce medial compartment load & hence exert their beneficial action on knee arthritis.

The art & science behind the unloading brace

All valgus unloading braces exert their mechanical effect by two mechanisms [7]:

1. Integrated valgus angle at the hinge (varies from manufacturer to manufacturer) that contributes to a fixed amount of correction that is pre-dialled & not amenable to any change.

2. An adjustable force strap system that comprises of a strap running spirally down the lower thigh & knee. This generates the familiar 3 point force system (used extensively in maintenance of fracture reduction casting &

flexible elastic nailing of paediatric long bones) that can be titrated through a strain gauge to match the level of correction/ pain relief required.

This component of correction is easily adjustable & can be done by the patient in a gradual manner.

The burden of knee osteoarthritis & the treatment gap

Worldwide, people are living longer & osteoarthritis primarily being a degenerative disease, continues to be a burden on healthcare systems [8]. The aetiology is multi-factorial, but there are some known risk factors like obesity, trauma & hereditary factors [9]. Degenerative osteoarthritis of the knee cannot be cured, joint replacement is the only recourse in end stage arthritis. In the earlier stages however, patient education, exercise, weight reduction, use of crutch/ cane & unloading braces are shown to be effective, along with certain pharmaceutical agents, primarily targeted for pain relief [10]. In uni-compartmental knee arthritis, the use of unloader braces has been shown to be an effective method to unload the knee in a biomechanics setting [11].

Clinical literature favouring unloading braces

Valgus bracing for knee arthritis has been reported to lead to functional pain improvement during walking & stairs at 1 week, 9 weeks, 12 weeks & 12 months [12]. A study using fluoroscopy during treadmill gait demonstrated articular surface separation at heel strike in 12 of 15 subjects wearing valgus knee braces, with an average change in condylar separation of 1.2 mm and condylar separation angle of 2.2° [13]. Measurements

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Guidelines	Recommendation
AAOS 2013	Inconclusive (Recommendation 4)
NICE, UK 2013, revised 2017	Recommended with conditions
EULAR 2000, revised 2003	Appliances – stick / insoles recommended
OARSI 2014	Recommended (insoles, braces)
RACGP 2018	Conditional recommendation against braces

Author's Preferred Indications and Contraindications	
Indications	Contraindications
1. Symptomatic KL Stage 2 and 3 OA	1. Inflammatory arthritis
2. Stage 4 OA unwilling for surgery (uncommon use)	2. Grossly deformed knees
3. Post medial meniscus root repair	
4. Following medial tibiofemoral cartilage surgery	

PEARLS OF WISDOM
<ul style="list-style-type: none"> • Knee osteoarthritis is as much a mechanical problem as a biological one. Orthotics for this condition includes knee braces and sleeves, and foot insoles and ankle foot orthotics. • These device are meant to reduce pain and improve function by a variety of bio-mechanical alterations like providing support, improving circulation and off-loading the involved compartment. • The current evidence propagating the application of any orthotic device is not strong and indeed disputed. It is hence, difficult to make strong recommendations for or against any device and the decision to use them is perhaps best individualized after discussing with the patient. • Orthotics probably do have a synergistic role with physical and biological therapies in the non-pharmacological management of early knee osteoarthritis. • In spite of limited evidence for the use of orthotics and braces in the non-operative treatment of osteoarthritis; these modalities still form an important link in the management of patients with mild to moderate knee osteoarthritis.

using force transducers have conclusively shown that valgus bracing reduces load on the medial tibio-femoral compartment, with a greater component of the reduction coming from the in-built valgus angulation & only a minor contribution from the strap [7]. The literature on these unloader braces is a mixed bag favouring their use in knee OA to finding no improvement in symptoms. A

Cochrane review published in 2015 showed inconclusive evidence for the use of these devices [14]. Several other studies however find them efficacious & recommend their usage in their guidelines [15]. A recent randomised placebo controlled trial of unloader bracing versus sham bracing (unloader brace with the force strap taken off) demonstrated superior outcomes in terms of

pain relief & function in the Unloader brace group that was maintained at the end of 1 year follow up [16].

Problems with the unloader brace

The unloader brace is generally well tolerated by most patients with minor mechanical issues like mismatch of brace to limb size, pressure sore & discomfort (India has a predominantly tropical climate). The cost factor of the brace also makes it difficult to procure for most patients who sometimes don't perceive a value for money kind of return for their investment. A recent study using finite element modelling deduced that valgus angles of greater than 8 degrees might initiate lateral compartment OA by loading regions of the lateral cartilage that are not meant for taking load [17]. This study also conclusively showed the unloading effect on the medial tibiofemoral compartment post meniscectomy that opens doors for certain off label indications like after a medial meniscal root repair, microfracture etc [17].

Conclusions

Insoles for the management of Knee osteoarthritis do not have a place in the treatment armamentarium of the modern Orthopaedic surgeon. Unloader braces can however be considered in early stages of arthritis (KL 2 & 3) for symptom alleviation after a fair trial. Sometimes it is difficult for the patient to know whether they have actually benefitted from usage of the brace. Using a standardised knee score like the Oxford Knee Score before & after brace usage may help the patient decide whether the investment of money & effort in the brace is worthwhile. The role of weight reduction & exercise must however be constantly emphasised to the patient throughout the entire treatment spectrum of Knee osteoarthritis regardless of its severity.

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