



Conservative Techniques of Malalignment Correction in Management of Knee Osteoarthritis: A Review

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ABSTRACT

Osteoarthritis (OA) is a disorder which is characterised by pain and decreased Range of motion. OA is a disease process of axial and peripheral joints. It is characterized by progressive deterioration and loss of articular cartilage and by reactive bone changes at the margins of the joints and in the sub-chondral bone. It is a progressive disorder of the joints. Knee is the most commonly affected joints. Its management can be pharmacological, non pharmacological or surgical. Amongst the nonpharmacological and surgical management a very important goal of management is correction of the malalignment of the joint. This malalignment is because of improper loading of the knee joint and is responsible for a lot of symptoms and disease progression. This can be done conservatively by bracing, taping and shoe modifications. The purpose of this article is to review the existing conservative methods and techniques available to correct and manage biomechanical malalignments evident in knee osteoarthritis

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I. Introduction

Osteoarthritis (OA) is a clinical syndrome characterised by decreased quality of life (QOL) because of pain and disability. Knee OA is the most common type of OA seen in clinical practise¹⁻⁴. It is a chronic degeneration of the articular cartilage around a joint. Even though it is most commonly seen in individuals over 45 years of age it can occur at any time. Primary OA has no definite cause but it is predisposed in individuals who are obese and who have a higher genetic susceptibility. Secondary OA has aetiology like previous injury to the knee joint, etc. It can affect either one (unilateral) or both (bilateral) of the knee joint. It occurs more commonly on the inner (medial) aspect of the knee thus involving the medial compartment. Knee osteoarthritis is common in individuals who play intense physical sports, such as football. Previous injury to the knee is a strong indicator for development of osteoarthritis in the future. Symptoms are known to develop slowly over a number of years.⁵

Management of OA is dependent on the stage of OA. It includes pharmacological, non-pharmacological or surgical intervention. Non-pharmacological interventions are the mainstay management strategies for knee OA in early phases as well as post surgically. Non-pharmacological interventions, which often involve the clinical input of the multidisciplinary health care team, include patient education, aerobic and resistive exercises, lifestyle changes and weight loss, electrotherapy, mechanical therapy and manual therapy. These interventions generally have low or no side effects and can be used in conjunction with a pharmacological regimen to decrease pain and promote functioning and quality of life.⁶⁻⁷

Surgery is generally reserved for those patients with osteoarthritis that is particularly severe and unresponsive to the conservative treatments and in whom the Activity of daily living is drastically affected. The main aims of surgical management

are to decrease pain, increase ROM and decrease the disability thus bringing about an increase in QOL of the patient. Arthroscopy, Osteotomy, Arthrodesis, and Arthroplasty are the surgical procedure to bring pain relief and improved function.⁵

II. Biomechanical alterations taking place in OA

The cycle of changes in OA include cartilage destruction, bony changes (cyst formation, osteophytes etc) and soft tissue changes around the joint. Soft tissue changes are not necessarily taking place in the affected joint, they can occur in the joint above or below too. Uni-compartmental knee OA is more commonly seen that to with the medial compartment involvement. This leads to a Varus knee deformity. Lateral compartment Knee OA is associated with Valgus deformity.

In the normal knee the mechanical axis of the knee joint passes almost through the centre of the knee joint. It shifts medially with varus and laterally with valgus deformity. This leads to abnormal loads on the joint⁸⁻¹⁰. Increased load across the joint is important in the pathogenesis of knee OA. Interventions that alter knee load may reduce symptoms and slow disease progression in patients with knee OA. The external knee adduction moment determines load distribution across the medial and lateral tibial plateaus, with force across the medial compartment almost 2.5 times that of the lateral. This may explain the much higher prevalence of medial compared with lateral tibiofemoral joint OA.¹¹

The magnitude of the adduction moment is partly determined by the mechanical alignment of the knee. In medial knee OA, mechanical alignment becomes varus as the medial joint space narrows. Varus malalignment causes the ground reaction force vector to pass more medially to the knee joint centre, resulting in a higher knee adduction moment.^{12,13} This also leads to increased attrition of the Subchondral bone.

Recent research has found that a higher adduction moment is associated with more severe knee pain and greater

radiographic disease severity.^{11,14,15} Longitudinal studies have demonstrated that as little as a one-unit increase in the adduction moment is associated with up to a 6.5-fold increase in the risk of disease progression.^{11,16} Similarly, knee joint varus malalignment is also correlated with disease progression. Given the importance of the knee adduction moment and joint alignment with regard to both symptom severity and disease progression in knee OA, conservative strategies to alter these biomechanical factors constitute a logical rehabilitative approach.^{15,17,18}

III. Malalignment correction

OA is that the most typical rheumatic condition, and symptomatic OA of the knee could be a vital supply of incapacity and impaired quality of life.^{19,20} Despite this impact, OA management remains mostly palliative and usually focuses on oral analgesics instead of aberrant biomechanical loading that underlies abundant of its progression. Surgeons have used surgical wedge osteotomy for several years to correct varus angulations by shifting weight off from the pathologic knee compartment OA. In OA of the knee, elevated joint loads are directly related to radiographic severity, illness progression, and pain, whereas in distinction, reduction of loading at the knee could yield vital symptomatic edges.²¹⁻²⁴

Correction of malalignment is one of the most difficult and challenging tasks faced by the physiotherapist in daily clinical practice. This can be achieved by- shoe modification, bracing and taping.

IV. Shoe modifications

The Osteoarthritis research society International (OARSI) issued guidelines for the management of knee OA that suggest that “every patient with hip or knee OA ought to receive recommendations regarding applicable footwear”.²⁵ Traditionally, footwear has been designed to produce most foot support and luxury, and tiny attention has been paid to the mechanical effects of shoes on the remainder of the lower extremity. However, the complete lower extremity is understood to be an interrelated functional and mechanical unit and alterations at one facet of the lower extremity (e.g., the foot) will have vital impact on distant areas like the knee. Therefore, the planning of footwear itself could well have an effect on the loading patterns of the complete lower body, and these biomechanical effects could have vital implications for conditions during which mechanical factors area unit are to the pathological process and progression of disease, like OA of the knee.

On the basis of current research, clinical recommendations for the use of lateral wedge insoles in people with medial knee osteoarthritis include:

1. Wedge for the full length of foot not just heel.
2. Wedge tilt of around 5° as greater tilt (10°) is more likely to be associated with discomfort.
3. Addition of elastic subtalar strapping or ankle support may improve wedge effectiveness (but may also increase the likelihood of adverse effects and a larger shoe may be required to allow fitting).
4. Daily usage of 5-10 hours may be optimal.
5. Wedges should be worn in shoes with flat heel and without medial arch supports.
6. Wedges should immediately reduce pain, if longer term clinical benefits are to be achieved.

7. Patients who achieve greatest benefits may include those who are younger, are less obese, have less severe disease and have greater lower limb lean muscle mass.

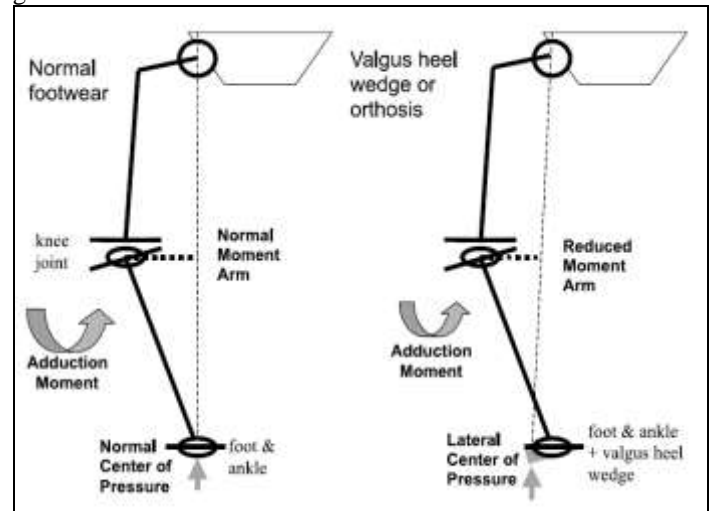


Fig: 1 Abnormal malalignment of the knee and its correction after lateral wedge

Both full-length lateral-wedge insoles and neutral-wedge insoles are constructed from a custom cork composite similar to Thermocork with a density of 60 durometers. The material is engineered to provide shock absorption and high resistance to compressive deformation. The insoles are manufactured with a mediolateral incline of 4° for the lateral-wedge insole and 0° for the neutral-wedge insole. Both the lateral and neutral wedge insoles are cut to fit the individual shoe, designed with peel-and-stick self-adhesive, and placed under the removable insert that came in the shoes.²⁶



Fig:2 Lateral Wedge

Lateral wedge is also made up of Silicon rubber. This silicon rubber has a 10 mm lateral elevation and a 75 mm width, which has an approximately 7.6 inclination. This silicon rubber material is usually used for cosmetic remodelling and has a natural form-fit to the skin. The 75 mm width silicon rubber is scaphoid shaped.

The unloading of the knee compartments can also be brought about by lateral wedge insole for medial compartment & medial wedge for lateral compartment^{4,6}. Most of the research work conducted is on medial compartment because of its high incidence. Lateral wedge is reported to have decreased the various stress by 4-12% as compared to control in patients with medial compartment osteoarthritis²⁷⁻²⁸. Malalignment has not improved when lateral wedge is compared to a neutral insert as reported in RCT's²⁹⁻³¹.

V. Taping

Taping for the knee OA is used for short term or intermittent management. It is hypothesized that a reduction in pain is achieved by taping. This can be attributed to improving the alignment of the patellofemoral joint &/ or unloading of the inflamed soft tissue structure^{6,32,33}. According to osteoarthritis public health agenda intervention white paper (2011) taping is the only biomechanical intervention which has given clinically & statistically significant result in chronic knee pain & function³³. Various RCT's have demonstrated the short & immediate effects of taping on pain^{34,35}. This change has been attributed to improvement or correction of patellar alignment changes in proprioceptive acuity, better function & activation of muscles^{6,32,34,35}. The usual technique used is medial glide, medial tilt & antero posterior tilt. To prevent the stretching of the inflamed soft tissue structure taping should also be applied to the infrapatellar fat pad or/and pesanserinus. Taping is generally considered to be a highly specialized technique but Hinman R.S³² (2003) concluded that specialist physiotherapist is not required for this intervention to be effective. They also recommended that the patient could be taught to tape their own knee thus providing them with self management strategy. Taping is a recommended treatment technique in knee OA by the American college of Rheumatology. Some factors which must be considered when using taping are skin care & adverse reaction of tape itself skin damage is usually associated with frequent removal of the tape. This may risk may increase manifold when dealing with frequent removal in a geriatric population⁶. Thus before applying tape skin condition must be examined & removal & reapplication of the tape should be less^{34,35}.

VI. Bracing

EULAR recommendations (2003) & NICE (2008) both have recommended braces, joint supports & insoles as a part of the non- pharmacological management of knee OA^{1,36}. Most of the evidence available is on the efficacy of the techniques on medial compartment Knee OA & there is a dearth of the studies on lateral compartment OA. This can be attributed to the lesser prevalence of the later^{29,37}. This may also be because of lesser affectivity of varisation bracing in lateral compartment OA^{29,37}. The variety of braces available in the market is numerous. There can be simple pull on neoprene sleeve^{6,29,37} or semi rigid brace^{6,38}. It is suggested that when there is no specific compartment of the joint to be unloaded neoprene sleeve will be more effective²⁹. There is evidence to show that the sleeve can also decrease pain. Mechanical support provided by the neoprene sleeve is minimal so it is postulated that better stability is because of decrease in pain and increased proprioception can be held accountable for decrease in pain. There is an increased load on the medial compartment of the knee during stance phase because of body weight and adduction moment that is created.

A decrease in this adduction movement is the primary aim of valgus bracing^{39,44}. These braces bring a decrease in pain & disability & improvement in function by stabilizing & off loading the joint & decreasing the muscular contraction⁴⁵. This brace is supported to apply an external abduction movement which will be working against the adductor moment hence shifting the centre of pressure from medial compartment^{41,43-44}. Because it applies the valgus moment it is called a valgus brace⁴⁶. Several studies have been conducted on valgus brace & its comparison to neoprene sleeves & it has also been compared with no brace^{6,29,36-39}. Cochrane Review documents it as a silver

level of evidence for the efficiency of brace for OA knee of the medial compartment^{29,37}. Kirkley et al (1999) reported significant improvement in performing functional tasks in both his experimental groups (varus unloader & neoprene sleeve) as compared to no brace group. Amongst the two experimental groups varus unloaded had significantly better results than the sleeve group³⁷. Richard J.D. et al (2005) compared the kinetic & kinematic effects of valgus brace with simple hinged brace. They reported an improvement in both the group & it was concluded that the valgus brace led to an increased confidence during loading & ability to push off vertically⁴⁶. Pollo et al (2002) reported an improvement in pain & activity level in all the patients in experimental group. They also reported a greater off loading in the medial compartment by increasing the valgus alignment. Their study provided biomechanical insights into understanding the mechanism by documenting the varus loads taken by the brace & the effect that it had on the loading of the medial compartment⁴¹. Ramsey D K et al (2007) tried to understand the degree of control provided by the valgus brace to the instability & its secondary effects on the muscular contraction during gait cycle. It was reported that the valgus brace improves the alignment of the knee thereby decreasing pain, disability, muscular contraction & the varus moment of the knee⁴⁵. Bringminglam PT et al (2001) reported little improvement in proprioception of the knee with valgus bracing⁴⁴. The valgus brace has certain disadvantage. It decreases the knee flexion during swing phase⁴⁶ which in turn leads to an apparent increase in length & decreased foot clearance stride. Weight of the brace, difficulty in application & decreased level of comfort are other disadvantageous factors reported in the literature⁶. It has limited effect on obese patients⁶.

VII. Conclusion

The effectiveness for these mal alignment correction techniques is minimal for the medial compartment knee OA and it is almost nonexistent for lateral compartment knee OA. But this is not necessarily attributed to lack of effects but may also be because of the lack of good quality studies. Even though the literature has reported some acute or short term improvements in the patient's condition long term work has not been done or reported.

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