

## Valgus Knee Bracing for Medical Gonarthrosis

Horlick Simon G. B.Sc. M.D.; Loomer, Richard L. B.A., M.D.  
Clinical Journal of Sport Medicine: [October 1993](#)

A double crossover study was designed and carried out on 39 patients to test the efficacy of valgus bracing using a GII brace in patients with medial gonarthrosis. Two brace designs were studied—one with a medial and one with a lateral hinge. The double crossover technique involved evaluating each patient under conditions of no brace, brace in neutral, and brace in valgus, each for a period of 6 weeks. Pain and function were recorded by subjects on diary forms daily and at the end of each week. Standing posterior-anterior radiographs were done on all patients under conditions of weight bearing, nonweight bearing, without brace, and with brace in valgus. Statistical analysis using repeated measures analysis of variance showed statistically significant pain relief compared to baseline with both a lateral hinge in valgus ( $p = 0.02$ ) and a medial hinge in valgus ( $p < 0.0001$ ). No significant change in function was found and no significant radiographic evidence of change in femoral-tibial angle or joint space alteration was demonstrated. Seventy-four percent of patients purchased their brace at the end of the study. Follow-up at an average 20 months after the study showed 58% of the patients with a lateral hinge and 93% of the patients with a medial hinge were still using their braces as the principal form of therapy. Valgus bracing using a GII brace, especially with a medial hinge, can be a useful treatment modality for reducing pain in the patient with medial gonarthrosis to replace or delay surgery.

### Crossfire OA Claims Supported

Pain Reduction Knee OA

## Generation II knee bracing for severe osteoarthritis of the knee

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DOI: 10.1016/S0003-9993(97)90083-6 · Source: [PubMed](#)

**Hiroaki Matsuno, Ken Morris Kadowaki, Haruo Tsuji**

### Abstract

To investigate the clinical efficacy of the Generation II (G II) knee brace, a newly developed knee orthosis, on patients experiencing severe medial compartment osteoarthritis (OA) of the knee. Case series. A national medical and pharmaceutical hospital in Japan. Twenty primary OA subjects (excluding those with secondary OA), all older than 55 years of age and experiencing only knee joint problems, were selected according to their ability to walk more than 500 meters independent of support. These patients had arthritis in both knees and no less than one half of normal joint space remaining as revealed by roentgenogram studies. The more severely affected side was selected for bracing. For 12 months, each patient wore a G II knee brace on the affected knee on a daily basis, removing it only at night. To evaluate the effects of G II OA brace alone, additional use of new oral drugs or any other treatment was prohibited from 1 month before application of the G II OA brace and throughout the trial period. Clinical efficacy was evaluated using the Japan Orthopaedic Association's knee scoring system. X-ray evaluation was performed with patients standing on one leg. A dynamometer was used to evaluate isokinetic quadriceps muscle strength. The center of gravity was measured using an X-Y recording. Clinical evaluation was performed every 2 months thereafter. Final evaluation was at 12 months. Nineteen of the 20 patients answered that they experienced significant pain relief. Knee pain scores on walking increased from 18.0 to 21.5 and on ascending and descending stairs increased from 12.8 to 15.8. The femorotibial angle decreased in 12 of the patients, and the mean angle decreased from 185.1 degrees before application to 183.7 degrees with the brace on at the final observation

period. In addition, isokinetic quadriceps muscle strength increased from an average of 36.8 Nm to 42.8 Nm for all patients. In 17 patients, quadriceps muscle strength increased, while it decreased in 2 and remained the same in 1. Finally, lateral movement of the center of gravity decreased compared with before G II application in all patients. G II bracing is a beneficial treatment for severe medial OA of the knee.

### **Crossfire OA Claims Supported**

Pain Reduction Knee OA

Functional Improvements Knee OA

Reduction of Unicompartmental Load

### **The Effect of Bracing on Varus Gonarthrosis\***

Article in [The Journal of Bone and Joint Surgery](#) 81(4):539-48 · April 1999

DOI: 10.2106/00004623-199904000-00012 · Source: [PubMed](#)

**A Kirkley, Susan Webster-Bogaert, Robert B Litchfield, A Amendola**

#### Abstract

The purpose of this study was to compare a custom-made valgus-producing functional knee (unloader) brace, a neoprene sleeve, and medical treatment only (control group) with regard to their ability to improve the disease-specific quality of life and the functional status of patients who had osteoarthritis in association with a varus deformity of the knee (varus gonarthrosis). The study design was a prospective, parallel-group, randomized clinical trial. Patients who had varus gonarthrosis were screened for eligibility. The criteria for exclusion included arthritides other than osteoarthritis; an operation on the knee within the previous six months; symptomatic disease of the hip, ankle, or foot; a previous fracture of the tibia or femur; morbid obesity (a body-mass index of more than thirty-five kilograms per square meter); skin disease; peripheral vascular disease or varicose veins that would preclude use of a brace; a severe cardiovascular deficit; blindness; poor English-language skills; and an inability to apply a brace because of physical limitations such as arthritis in the hand or an inability to bend over. Treatment was assigned on the basis of a computer-generated block method of randomization with use of sealed envelopes. The patients were stratified according to age (less than fifty years or at least fifty years), deformity (the mechanical axis in less than 5 degrees of varus or in at least 5 degrees of varus), and the status of the anterior cruciate ligament (torn or intact). The patients were randomly assigned to one of three treatment groups: medical treatment only (control group), medical treatment and use of a neoprene sleeve, or medical treatment and use of an unloader brace. The disease-specific quality of life was measured with use of the Western Ontario and McMaster University Osteoarthritis Index (WOMAC) and the McMaster-Toronto Arthritis Patient Preference Disability Questionnaire (MACTAR), and function was assessed with use of the six-minute walking and thirty-second stair-climbing tests. The primary outcome measure consisted of an analysis of covariance of the change in scores between the baseline and six-month evaluations. One hundred and nineteen patients were randomized. The control group consisted of forty patients (thirty-one men and nine women; mean age, 60.9 years); the neoprene-sleeve group, of thirty-eight patients (twenty-seven men and eleven women; mean age, 58.2 years); and the unloader-brace group, of forty-one patients (twenty-eight men and thirteen women; mean age, 59.5 years). Nine patients withdrew from the study. At the six-month follow-up evaluation, there was a significant improvement in the disease-specific quality of life ( $p = 0.001$ ) and in function ( $p < 0.001$ ) in both the neoprene-sleeve group and the unloader-brace group compared with the control group. There was a significant difference between the unloader-brace group and the neoprene-sleeve group with regard to pain after both the six-minute walking test ( $p = 0.021$ ) and the thirty-second stair-climbing test ( $p = 0.016$ ). There was a strong trend toward a significant difference between the unloader-brace group and the neoprene-sleeve group with regard to the change in the WOMAC aggregate ( $p = 0.062$ ) and WOMAC physical function scores ( $p = 0.081$ ). The results indicate that

patients who have varus gonarthrosis may benefit significantly from use of a knee brace in addition to standard medical treatment. The unloader brace was, on the average, more effective than the neoprene sleeve. The ideal candidates for each of these bracing options remain to be identified.

**Crossfire OA Claims Supported:**

Pain Reduction Knee OA  
Functional Improvements Knee OA

**Change of bone mineral density with valgus knee bracing**

[Y. Katsuragawa](#), [N. Fukui](#), and [K. Nakamura](#)

We assessed the clinical knee score and bone mineral density of the proximal tibia in an attempt to evaluate the efficacy of valgus knee bracing. The knee score improved after 3 months, and increases in bone mineral density were seen more in the lateral tibial condyle than in the medial. These results suggest that the brace acts by transferring the forces across the knee joint from the medial to the lateral side.

**Crossfire OA Claims Supported:**

Pain Reduction Knee OA  
Functional Improvements Knee OA  
Reduction of Unicompartmental Load

**Improvement in function after valgus bracing of the knee. An analysis of gait symmetry**

[The Bone & Joint Journal](#) 82(7):1001-5 · September 2000  
DOI: 10.1302/0301-620X.82B7.0821001 · Source: [PubMed](#)

**Draper, ER; Cable, JM; Sanchez-Ballester, J; Hunt, N; Robinson, JR; Strachan, RK**

The use of a valgus brace can effectively relieve the symptoms of unicompartmental osteoarthritis of the knee. This study provides an objective measurement of function by analysis of gait symmetry. This was measured in 30 patients on four separate occasions: immediately before and after initial fitting and then again at three months with the brace on and off. All patients reported immediate symptomatic improvement with less pain on walking. After fitting the brace, symmetry indices of stance and the swing phase of gait showed a consistent and immediate improvement at 0 and 3 months, respectively, of 3.92% ( $p = 0.030$ ) and 3.40% ( $p = 0.025$ ) in the stance phase and 11.78% ( $p = 0.020$ ) and 9.58% ( $p = 0.005$ ) in the swing phase. This was confirmed by a significant improvement at three months in the mean Hospital for Special Surgery (HSS) knee score from 69.9 to 82.0 ( $p < 0.001$ ). Thus, wearing a valgus brace gives a significant and immediate improvement in the function of patients with unicompartmental osteoarthritis of the knee, as measured by analysis of gait symmetry.

**Crossfire OA Claims Supported:**

Pain Reduction Knee OA  
Functional Improvements Knee OA

## **Reduction of Medial Compartment Loads with Valgus Bracing of the Osteoarthritic Knee**

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Background: Patients with medial compartment osteoarthritis of the knee may be treated nonoperatively with adjustable valgus bracing.

Hypothesis: Valgus bracing reduces load on the medial compartment through the application of an external valgus moment about the knee, resulting in pain relief.

Study Design: Prospective cohort study.

Methods: Eleven patients were tested using an instrumented brace and three-dimensional gait analysis. We measured the valgus moment applied by the adjustable valgus brace and determined the compressive load in the medial compartment. We also documented the effects of increased valgus alignment of the brace and increased strap tension on load sharing. Pain and activity levels were also recorded.

Results: Pain and activity level improved in all subjects with valgus bracing. During gait, valgus bracing reduced the net varus moment about the knee by an average of 13% (7.1 N•m) and the medial compartment load at the knee by an average of 11% (114 N) in the calibrated 4° valgus brace setting. Increasing valgus alignment with the adjustable brace had a greater effect on the medial compartment load than did increasing strap tension.

Conclusion: Adjustable valgus bracing was effective in reducing medial compartment load and subsequent pain while also improving knee function in a group of patients with osteoarthritis.

### **Crossfire OA Claims Supported:**

Pain Reduction Knee OA

Functional Improvements Knee OA

Reduction of Unicompartmental Load

### **A comparison of knee braces during walking for the treatment of osteoarthritis of the medial compartment of the knee**

Richards, J.D.; Sanchez-Ballester, J.; Jones, R.K.; Darke, N.; Livingstone, B.N.

**The Bone and Joint Journal**, 1 Jul 2005 <https://doi.org/10.1302/0301-620X.87B7.16005>

In this cross-over study, we evaluated two types of knee brace commonly used in the conservative treatment of osteoarthritis of the medial compartment. Twelve patients confirmed radiologically as having unilateral osteoarthritis of the medial compartment (Larsen grade 2 to grade 4) were studied. Treatment with a simple hinged brace was compared with that using a valgus corrective brace. Knee kinematics, ground reaction forces, pain and function were assessed during walking and the Hospital for Special Surgery scores were also determined.

Significant improvements in pain, function, and loading and propulsive forces were seen with the valgus brace. Treatment with a simple brace showed only significant improvements in loading forces. Our findings suggest that although both braces improved confidence and function during gait, the valgus brace showed greater benefit.

Osteoarthritis (OA) of the knee affects approximately 80% of individuals by the age of 55 years.<sup>1</sup> It is more prevalent in the medial compartment<sup>2</sup> and it is estimated that during normal gait approximately 60% to 80% of the load is transmitted through the medial side.<sup>3</sup> This will increase any pain and functional impairment in an osteoarthritic joint.<sup>4</sup>

Management of OA of the medial compartment of the knee in active individuals who are unsuitable for surgery is a challenge. High tibial osteotomy is said to contraindicate unicompartmental arthroplasty.<sup>5</sup> Consequently, other forms of conservative management require consideration once traditional methods such as loss of weight, active exercises and analgesia have failed.

Valgus bracing attempts to reduce excessive compartmental loading and increase function. The brace unloads the painful compartment by applying a three-point force system.<sup>6</sup> Increased activity and reduced pain might then delay the need for operation.<sup>7,8</sup>

Several studies on the use of valgus braces report that patients have considerable relief from pain, improved function,<sup>6-10</sup> and a reduction in loading of the medial compartment.<sup>11</sup> Few studies have considered whether biomechanical changes relate to these perceived benefits. Draper et al<sup>12</sup> analysed the effects of a valgus brace on gait symmetry, and found that gait became more symmetrical both after the initial fitting and after wearing of the brace for three months. While concluding that the brace was clinically effective, no reason was given for its success.

The efficacy of bracing has been debated because, to combat varus, there is a need for large resistive moments which would be intolerable for most patients.<sup>13</sup> It is possible, however, that a brace might achieve increased function and a more symmetrical gait, through either increased proprioceptive feedback or a placebo effect which gives the wearer more confidence in the stability of their limb.

We have compared the kinematic and kinetic effects of a valgus brace with those of a simple hinged brace in a cross-over design study over a period of six months.

## **Patients and Methods**

Twelve physically active patients (seven men, five women) with a mean age of 60.2 years (50 to 75) were recruited from the general orthopaedic outpatient clinics of two hospitals. The subjects had unilateral OA of the medial compartment confirmed radiologically (Larsen grade<sup>12</sup> 2 to grade 4 on anteroposterior and Merchant's radiographs and Larsen grade 0 to grade 1 of the lateral compartment). The study had ethical approval and informed consent was obtained. All the patients had an abnormal varus mechanical axis (mean 6.8°; 1° to 12°). They had no significant hip, back or contralateral leg symptoms, had not undergone an arthroscopy within the preceding six months and were physically and mentally able to comply with the wearing of a brace.

Patients were assessed clinically using visual analogue scores<sup>12</sup> (VAS) for resting, standing, walking and climbing stairs and Hospital for Special Surgery<sup>12</sup> (HSS) activity and functional questionnaires. A decrease in VAS indicated a reduction in pain, and an increase in HSS score showing an improvement in activity and function. We have compared non-valgus (B1) and valgus (B2) bracing. Each patient was randomly allocated to either an 'off-the-shelf' hinged brace (Bilateral uniaxial hinge B1, Camp Healthcare, Sheffield, UK), or a Generation II ADJ Unloader (GII Orthotics Europe, Eindhoven, The Netherlands). The same fully-trained technician fitted both

types. Each patient was instructed in the use and care of the brace and advised to wear it all day for six months. Kinematic and kinetic gait analysis and the VAS and HSS scores were then determined again. The patients immediately received the second type of brace for a further six months, after which the analyses were repeated. During the study, the patients were advised to continue to take any current medication and not to begin new treatment.

### **Kinematic and kinetic gait analysis.**

The patient was asked to wear the same comfortable shoes for each gait analysis. They walked the length of the gait laboratory at their own speed and repeated this twice. Kinematic data were collected using a six-camera Proreflex MCU240 motion analysis system (Qualisys Medical AB, Gothenburg, Sweden) at 100 Hz. Retroreflective markers were placed on the anterior superior iliac spine, the centre of the greater trochanter, the superior aspect of the patella, the lateral joint line of the knee, the tibial tuberosity, the lateral malleolus and at the base of the fifth metatarsal. The data were smoothed with a Butterworth 4<sup>th</sup> order filter with a cut-off frequency of 6 Hz. Kinetic data were collected from two Kistler force platforms (Kistler Instruments Ltd, Hampshire, UK) at 200 Hz.

From the kinematic data, the mean values were found for the key points on the flexion/extension angular velocity graphs of the knee. Kinetic data provided the peaks and troughs of the vertical and anteroposterior ground reaction forces.

### **Statistical analysis.**

One-way analysis of variance (ANOVA) tests were performed with *post hoc* pairwise comparison for the kinematic and kinetic variables. P values compared the results of wearing both braces after six months with those before bracing. They also compared the effect of the two braces. Tests were performed for both the affected and unaffected sides. A level of significance was set at the 5% level for each test with a Bonferroni adjustment to reduce the chance of type-1 errors.

## **Results**

### **Knee angle.**

The flexion pattern of the knee on the affected side showed a significant reduction of flexion during the swing phase with bracing ([Table I](#)).

### **Knee angular velocity.**

The pattern of angular velocity of the knee showed no significant differences between the three conditions on the affected and unaffected sides.

### **Ground reaction forces.**

The ground reaction forces on the affected side showed a significant increase during loading and push-off ([Table II](#)).

### **VAS and HSS scores.**

Details are given in [Tables III](#) and [IV](#).

At the initial assessment the mean modified HSS score was 49.3 (37 to 62; [Table IV](#)). After wearing the B2 brace for six months this had increased to 65.7 (42 to 92;  $p < 0.002$ ). Wearing of

the simple hinged brace gave a slight increase in the HSS score to 53.5 (31 to 84), but this was not statistically significant.

All patients initially reported moderate to severe pain on walking and using stairs with a mean of 8.0 and 8.5, respectively (Table III). The mean scores for resting and standing were less at 4.9 and 6.0, respectively. All patients reported subjectively less pain on walking, independent of the brace used.

## Discussion

Most previous studies of valgus bracing have concentrated on the clinical effects of one or more types of brace. Kinetic data showed that the B2 brace produced significantly greater loading forces in the vertical and posterior directions, and a significant increase in the propulsive vertical forces. Improvements in the anterior propulsive force were observed, but were not significant. These data reflect improved confidence during loading and an ability to push-off vertically. The B1 brace showed improvement in vertical and posterior loading but not to the same extent. No improvement in propulsion was seen with the B1 brace. Both showed a trend towards a more normal gait pattern and clinically better function. Significant improvement in the HSS score was seen only with the B2 brace.

The increase in the loading forces may not be viewed as positive since this could suggest that there was more load on the medial compartment. However, the VAS results showed significant reduction in pain while resting, walking and stair-climbing with the B2 brace. This indicates that the increased load is not causing pain but is reduced by support from the brace. This view is supported by Kirkley et al<sup>10</sup> and Lindenfeld et al.<sup>7</sup>

The B1 brace gave increased loading forces, but no significant reduction in pain. The implication is that the simple hinged brace has an improved effect on confidence in loading without increasing pain. This complies with the theoretical action of such a brace to be supportive, but not as supportive in the coronal plane as a valgus brace. The differences between the B1 and B2 braces suggest that the benefits of the latter are not just confidence or placebo effects.

The valgus brace had a functional drawback. It caused significant reduction of flexion during the swing phase. This restriction can result in reduced foot clearance and a shorter stride. The simple hinged brace had no such restriction. Possible causes of restriction are that the valgus brace is significantly larger and, with only a single hinge, is prone to torsional misalignment.

Patient compliance was not recorded, but since most patients had benefit from both braces, we believe that compliance was high. Some patients reported that the valgus brace was bulky, but continued to wear it for the specified six months.

It could be argued that over the study period, deterioration in OA would be seen. However, there was no such deterioration.

Our study supports the use of valgus knee braces as an alternative treatment option for carefully selected patients with OA of the medial compartment. Further work is required to analyse the restriction of movement produced by the brace during the swing phase and whether different designs of brace could improve on this.

### **Crossfire OA Claims Supported:**

Pain Reduction Knee OA

Functional Improvements Knee OA

## **In Vivo Three-Dimensional Determination of the Effectiveness of the Osteoarthritic Knee Brace: A Multiple Brace Analysis**

Nadaud, Matthew C., MD; Komistek, Richard D., PHD; Mahfouz, Mohamed R., PHD; Dennis, Douglas A., MD; Anderle, Matthew R., BS

JBJS: [December 2005 - Volume 87 - Issue suppl 2 - p 114-119](#)

doi: 10.2106/JBJS.E.00482

Scientific Exhibits

### **Crossfire OA Claims Supported:**

Reduction of Unicompartmental Load

## **A MECHANICAL HYPOTHESIS FOR THE EFFECTIVENESS OF KNEE BRACING FOR MEDIAL COMPARTMENT KNEE OSTEOARTHRITIS**

[Dan K Ramsey](#), PhD, [Kristin Briem](#), PT, MHSc, [Michael J Axe](#), MD, and [Lynn Snyder-Mackler](#), ScD, PT, SCS

### **Background**

Evidence that knee braces used for the treatment of osteoarthritis mediate pain relief and improve function by unloading the joint (increased joint separation) remains inconclusive. Alternatively, valgus braces may mediate pain relief by mechanically stabilizing the joint and reducing muscle co-contractions and joint compression. This study therefore sought to examine the degree to which unloader knee braces control knee instability and influence muscle co-contractions during gait.

### **Methods**

Sixteen subjects with radiographic evidence of medial compartment knee osteoarthritis and malalignment were recruited and fitted with a custom Generation II Unloader Brace. Gait analysis was performed with the knee unbraced and with the brace in neutral alignment and 4° valgus. A two week washout period separated brace conditions. Muscle co-contraction indices were derived for agonist and antagonist muscle pairings. Pain, instability and functional status were assessed using self-report questionnaires. Repeated-measures ANOVA's, correlations and regression analysis were used for statistical analysis.

### **Results**

The scores for pain, function and stability were worst when the knee was unsupported (baseline and washout). At baseline, 9 of 16 subjects reported knee instability, of which 5 complained it affected activities of daily living. Poor knee stability was significantly correlated with decreased activities of daily living, quality of life, global knee function and higher pain and symptoms. Knee function and stability scored highest with the neutral brace compared to the valgus brace. Vastus lateralis-lateral hamstring and vastus medialis-medial hamstring muscle co-contractions were significantly reduced as a result of bracing. Subjects with greater varus alignment exhibited greater decreases in vastus lateralis-lateral hamstrings co-contraction.

### **Conclusion**

Neutral alignment performed as well or better than valgus alignment, in reducing pain, disability, muscle co-contraction, and knee adduction excursions. Pain relief may result from diminished muscle co-contractions rather than so called medial compartment unloading.

### **Crossfire OA Claims Supported:**

Pain Reduction Knee OA

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