# UC Irvine

## UC Irvine Previously Published Works


### Title

Return to Work and Sport After Distal Femoral Osteotomy: A Systematic Review


### Permalink

https://escholarship.org/uc/item/23d2t133



### Journal

Sports Health A Multidisciplinary Approach, 14(5)

### ISSN

1941-7381



### Authors

Bassi, Jaspal S

Chan, Justin P

Johnston, Tyler

et al.



### Publication Date

2022-09-01

### DOI

10.1177/19417381211041072



### Copyright Information

This work is made available under the terms of a Creative Commons Attribution License, availalbe at https://creativecommons.org/licenses/by/4.0/

Peer reviewed

eScholarship.org Powered by the California Digital Library
University of California

# Return to Work and Sport After Distal Femoral Osteotomy: A Systematic Review

Jaspal S. Bassi, BS,[†] Justin P. Chan, MD,[†‡] Tyler Johnston, MD,[†‡] and Dean Wang, MD*[†‡]

**Context:** Distal femoral osteotomy (DFO) is a joint preservation procedure that corrects genu valgum deformities and patellofemoral maltracking, thereby restoring kinematics and unloading contact pressures in the lateral tibiofemoral and patellofemoral compartments.

**Objective:** To evaluate the rates of return to work (RTW) and return to sport (RTS) after DFO for valgus malalignment and lateral compartment osteoarthritis through a systematic review of the literature.

**Data Sources:** A systematic review using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines was conducted on the PubMed, Cochrane, and Embase databases.

**Study Selection:** The search terms *femoral osteotomy* AND (*sports* OR *work*) were used. Studies in which patients underwent concomitant total knee arthroplasty were excluded.

**Study Design:** Systematic review.

**Level of Evidence:** Level 4 (systematic review of level 4 studies).

**Data Extraction:** Data included the number of patients, age, gender, laterality of operation, time to follow-up, rate of RTW and RTS, time to RTS, activity level on return, and activity level scores (Tegner, Marx, Lysholm, and the International Knee Documentation Committee). Risk of bias was assessed using the Methodological Index for Non-Randomized Studies (MINORS) criteria.

**Results:** Seven articles with 194 patients were included. The average age ranged from 19 to 49 years with a mean postoperative follow-up range of 36 to 90 months. RTW data were available for 125 patients, of whom 42.1% to 91.3% returned by final follow-up. Data on RTS were available for 149 patients, of whom 70% to 100% returned at a range of 8.3 to 16.9 months postoperatively, and 41.6% to 100% returned to the same or greater level of sports activity. The Tegner and Marx activity level scores ranged from 3 to 4 and from 5 to 11, respectively, at final follow-up.

**Conclusion:** Patients treated with DFO reported high rates of RTW and RTS, with most patients being able to return to recreational sport after surgery.

**Keywords:** distal femoral osteotomy; return to sport; return to work; genu valgum; lateral compartment arthritis

Valgus deformities of the knee, whether occurring constitutionally or as a sequalae of trauma or partial meniscectomy, represent a significant challenge in the young and active population. Left untreated, valgus knee malalignment often leads to patellofemoral maltracking and increased lateral compartmental contact pressures, resulting in higher rates of chondral wear and osteoarthritis. Distal femoral osteotomy (DFO) is a joint preservation procedure that corrects genu valgum deformities and patellofemoral maltracking, thereby restoring kinematics and unloading contact pressures in the lateral tibiofemoral and patellofemoral compartments. Biomechanical studies have demonstrated a 20% to 30% reduction in lateral compartment contact pressures after DFO.[13,20] Clinical studies have described successful treatment after DFO with improvement in functional outcomes and long-term survivorship rates up to 87% at a minimum of 10 years.[6,17,19,20]

Although many studies have reported on clinical outcomes after DFO, there have been few studies characterizing return to

From [†]School of Medicine, University of California Irvine, Irvine, California, and [‡]Department of Orthopaedic Surgery, University of California Irvine, Orange, California.
*Address correspondence to Dean Wang, MD, Department of Orthopaedic Surgery, University of California Irvine, 101 The City Drive South, Pavilion III, Orange, CA 92868 (email: deanwangmd@gmail.com) (Twitter: @deanwangmd).

The following authors declared potential conflicts of interest: T.J. reports grants from Arthrex Inc, outside the submitted work. D.W. reports personal fees from Newclip, outside the submitted work.
DOI: 10.1177/19417381211041072
© 2021 The Author(s)

work (RTW) and return to sport (RTS) in these patients. For those who are engaged in physically demanding work or sport, RTW and RTS are arguably among the most clinically important outcome measures for these patients. Compared with clinical studies evaluating outcomes after high tibial osteotomy (HTO), the literature describing RTW and RTS after DFO is sparse, and there has been no review synthesizing the available data. The purpose of this systematic review was to evaluate the cumulative rates of RTW and RTS after DFO for valgus malalignment and lateral compartment osteoarthritis.

## METHODS

This study was performed in accordance with guidelines set forth by Harris et al[7] and the 2009 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement guidelines.[7]

### Study Eligibility

Inclusion and exclusion criteria were established before conducting the literature search. Inclusion criteria for this review consisted of any studies that reported measures of RTW or RTS in patients undergoing DFO for indications such as valgus deformities of the knee and lateral compartment osteoarthritis. Studies in which patients underwent previous and/or concomitant procedures such as cartilage/meniscus treatment, femoral/tibial derotational osteotomies, and tibial osteotomies were included in the review. Patients who underwent opening and closing wedge DFO were included in the analysis. There was no minimum follow-up period required of the studies. Exclusion criteria consisted of (1) review articles, (2) case reports, (3) editorials, (4) technical notes, (5) abstracts only, (6) animal studies, (7) studies in which patients underwent concomitant total knee arthroplasty, and (8) studies unavailable in the English language.

### Literature Search

A search of the literature and study identification was conducted in accordance with the 2009 PRISMA statement guidelines.[11] The PubMed, Cochrane, and Embase databases were searched in July 2020 using the search query *femoral osteotomy* AND *sport* OR *work*.

### Study Selection and Data Abstraction

Two independent reviewers conducted a search of the literature, and all results were compiled into a spreadsheet.[7] Journal articles were analyzed for duplicates and were filtered based on title and abstract. Those which did not describe any data on DFO or RTW/RTS were excluded. Of those articles remaining, full-text copies were digitally attained and analyzed for further inclusion/exclusion. Journal articles selected for inclusion were reviewed by both investigators. The references section of each study was also thoroughly examined for other relevant studies. For studies conducted at the same institution, the materials and methods section of each study was evaluated to ensure duplicate patient populations were not included in the review. All studies and the corresponding data were exported to a custom spreadsheet. Data extracted from each study included the publication characteristics of each article, number of participants, age, gender, laterality of operation, any concomitant procedures, time to follow-up, rate of RTW and RTS, time to RTW and RTS, activity level on return, and activity level scores.

### Risk of Bias Assessment

To assess the quality of the selected studies, each study was graded using the Methodological Index for Non-Randomized Studies (MINORS) checklist. The MINORS checklist is a quality assessment tool that utilizes a 12-criteria checklist to quantify the quality of nonrandomized studies. Each criterion is given a score of 0, 1, or 2, with 0 being not reported, 1 being inadequately reported, and 2 being adequately reported. Of the 12 criteria, 4 are applicable to comparative studies. Because there were no comparative studies collected for this review, the 4 criteria for comparative studies were omitted. Therefore, only 8 criteria were utilized. Thus, the highest score each study could receive was 16.[15] The included studies were scored by 2 independent raters. Differences in scores were discussed between reviewers for resolution and the total score and mean were calculated.

### Data Analysis

The primary outcome measures of this study were the rates of RTW or RTS in patients who underwent DFO. These are arguably some of the most important outcome measures when counseling patients regarding expectations after surgery, especially for the active population. Despite the importance of these measures, there is a paucity of literature describing rates of RTW or RTS after DFO. For RTW/RTS, the number of patients from each study who were involved in work or sports preoperatively and the number who returned to work or sports after DFO were recorded. Patients undergoing concomitant procedures were included in this analysis. A separate subanalysis of RTW/RTS was performed, which excluded patients treated with concomitant osteochondral allograft transplant, meniscal allograft transplant (MAT), microfracture, anterior cruciate ligament (ACL) reconstruction, and medial patellofemoral ligament (MPFL) reconstruction, as these procedures are expected to prolong recovery time after DFO. Other concomitant procedures, such as debridement, meniscectomy, and chondroplasty, were included in the subanalysis since these are unlikely to significantly affect recovery time after DFO. Secondary outcomes, including level of sports participation, time to RTS, and activity outcome measures, were recorded for each study. Because the studies included in this review were nonrandomized and methodologies were heterogenous, data were reported as ranges rather than pooled means to decrease the risk of bias.[3]

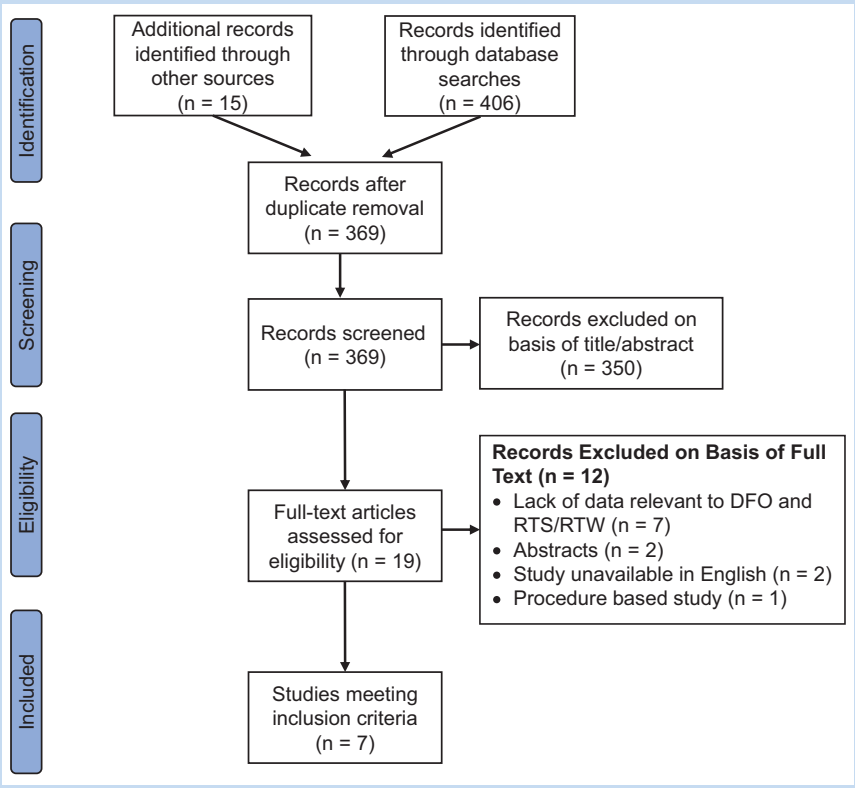


Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram for study selection. DFO, distal femoral osteotomy; RTS, return to sport; RTW, return to work.

# RESULTS

## Study Identification and Characteristics

A total of 7 articles were identified and included in the systematic review. The PRISMA flow diagram for study identification is depicted in Figure 1. A total of 406 articles were identified from the selected databases using the search criteria. An additional 15 articles were identified by reviewing the references section of selected studies. The average MINORS checklist score for the 6 studies was 8.3 (range, 6.5-10). The interclass correlation coefficient between raters was 0.92. All studies elicited in the systematic review were case series (Appendix 1, available in the online version of this article).

## Population Characteristics

A total of 194 unique patients were identified, of whom 110 (56.7%) were women and 84 (43.3%) were men. The mean age for each study ranged from 19 to 49 years. The mean postoperative time to follow-up ranged from 36 to 90 months. Among studies that provided laterality data, 61 (47.7%) patients underwent DFO on the right knee while 67 (52.3%) patients underwent DFO on the left knee. Among the studies that provided data on the degree of valgus malalignment, the mean amount of valgus deformity corrected for in each study ranged from 6.3° to 12°. Data from the the study by Hoorntje et al[8] were not included in Appendix 1 (available online) as this study detailed the mean degree of correction for each variation of procedures that were conducted. The mean degree of correction for isolated DFO was 7.9°, the data on other procedures can be found in the original text.[8] Of the total 194 patients, 71 (36.6%) underwent concomitant procedures and 72 (37.1%) patients underwent hardware removal after surgery (Appendix 1, available online). Of the patients who underwent concomitant procedures, 19 underwent MAT, and 7 underwent cartilage repair or restoration. Postoperative protocols for these studies typically restricted patients to partial weightbearing for the first 5 to 6 weeks and a progression to full weightbearing by 6 to 12 weeks.[1,2,4,8,18]

## RTW Outcomes

Three studies[4,8,14] reported data on the rate of RTW (Table 1). The total number of patients working before undergoing DFO was 125. One of these 3 studies focused on a population of active military service members.[14] The other 2 studies[4,8] did not report the type of work conducted by their populations, but recorded difficulty with tasks such as clambering, climbing stairs, squatting, and walking on rough terrain. The range of RTW in these studies was 42.1% to 91.3%. A subanalysis excluding patients who underwent concomitant procedures that may prolong recovery times found a RTW range of 43.8% to 91.3% after DFO. The mean follow-up time ranged from 38.4 to 48 months. The only study to report timing of RTW was that by

Table 1. Return to work (RTW) after distal femoral osteotomy

| | Total | | | Subanalysis[a] | | Follow-up in Months, Mean (Range) |
|---|---|---|---|---|---|---|
| Study | Patients | Mean Age, y | RTW, % | Patients | RTW, % | |
| Carvalho et al[4] | 26 | 48.6 | 88.5 | 26 | 88.5 | 48.0 (20-114) |
| Hoorntje et al[8] | 80 | 41.2 | 91.3 | 80 | 91.3 | 40.8[b] (16.8-62.4) |
| Rensing et al[14] | 19 | 29.3 | 42.1 | 16 | 43.8 | 38.4 (6-72) |
| Total | 125 | | | 122 | | |

[a]Subanalysis excluding any concomitant cartilage repair/restoration, meniscal transplantation, and ligament reconstruction.
[b]Median.

Hoorntje et al,[8] which reported timing of RTW as the number of patients who returned to work within 6 months of their procedure. They reported that 59 (80.8%) of 73 patients returned to work within 6 months after DFO.[8]

### RTS Outcomes

Six studies[1,2,4,8,12,18] reported data on the rate of RTS (Appendix 2, available online). The total number of patients involved in sports before the operation was 149. The range of RTS was 70% to 100%. A subanalysis excluding patients who underwent concomitant procedures that may prolong recovery times found that 70.6% to 100% returned to sport after DFO. Four studies[1,2,12,18] reported data on timing of RTS for 42 patients. The range of time for people to RTS was 8.3 to 16.9 months. The study conducted by Hoorntje et al[8] reported timing of RTS as percentage of patients who returned to sport within 6 months after their procedure. They reported that 46 (70.8%) of 65 patients returned to sport within 6 months of their procedure.[8] Five studies reported data on 54 patients regarding their sports activity level after their RTS.[1,2,4,12,18] Among these patients, 41.6% to 100% returned to the same or greater level of sports activity after DFO.

Data were also collected on activity level scores as measured by the Tegner Activity and Marx Activity Rating scales (Appendix 2, available oline). On the Tegner Activity Scale, a score of 0 represents those who are unable to work/play sports because of knee disability, while a score of 10 is given to elite professional athletes who are actively involved in competitive sports.[16] Two studies[4,8] reported the median Tegner Activity score for 125 patients. The preoperative Tegner score ranged from 3 to 4, while the postoperative Tegner score was 3 for both studies. A score in this range indicates individuals can participate in recreational low-impact sports such as swimming and cycling.[16] The Marx Activity Rating Scale is a 5-point (0-4) scale that grades running, cutting, deceleration, and pivoting. A score of 0 represents being able to complete each activity less than once a month, while a score of 16 represents being able to complete each activity at least 4 times a week.[10] Three studies[1,12,18] reported the mean Marx Activity Ratings for 47 patients. Two of these studies did not report the preoperative Marx Activity score and thus were not included in the analysis. The range of postoperative Marx Activity scores was 5 to 11. An average score of 5 represents being able to run, cut, decelerate, and pivot with a frequency of approximately less than once a month while a score of 11 represents the ability to do these tasks approximately 2 to 3 times a week.[10] Other activity or knee function outcome assessments such as Lysholm and International Knee Documentation Committee scores were recorded.

## DISCUSSION

The primary findings of this study found a range of RTW of 42.1% to 91.3% and a range of RTS of 70% to 100% after DFO for valgus malformations and lateral compartment osteoarthritis. A subanalysis excluding patients who underwent concomitant procedures expected to prolong recovery found that 70.6% to 100% returned to sport after DFO. Concomitant procedures included osteochondral allograft transplant, MAT, microfracture, ACL reconstruction, and MPFL reconstruction, as these procedures are expected to prolong recovery time after DFO. Of the patients who returned to sports, the time to return ranged from 8.3 to 16.9 months. The majority of patients who returned to sports reported an equal or higher activity level compared with their preoperative levels.

The rates of RTW and RTS found in this review are similar to a recent systematic review on RTW and RTS after HTO by Kunze et al.[9] Out of 1914 patients across 33 studies, they found pooled rates of RTW and RTS of 80.8% and 75.7%, respectively.[9] Because DFO is generally less commonly performed compared with HTO, this review included studies with patients who underwent concomitant procedures. Of the 194 patients included in the analysis, 36.6% underwent concomitant procedures. The inclusion of concomitant procedures in this study, while potentially confounding the effects of isolated DFO on RTW and RTS, provides data that can be more readily generalizable as many patients undergoing DFO also receive concomitant procedures. When excluding patients who received

concurrent MAT, ligament reconstruction, or cartilage repair, the rates of RTW and RTS ranged from 43.8% to 91.3% and from 70.6% to 100%, respectively, which were not substantially different from the overall rates.

Several extrapolations of the data are worth mentioning. All studies reported mean time to follow-up for their population aside from the study by Hoorntje et al,[8] which reported the median time to follow-up. For the purposes of this study, the median was assumed to be close to the mean and was recorded in Appendix 1 (available online). Additionally, the data from a study conducted by Rensing et al[14] were reported as number of knees (22) rather than patients (19) and included 3 patients who underwent bilateral DFO. They reported that 11 patients were unable to RTW after the procedure.[14] In this study, it was assumed that since 11 of 19 were unable to return to duty, the remaining 8 were able to and were counted in the RTW group. Additionally, the study by Rensing et al[14] reported military status at 2 years postoperatively and at final follow-up. For this analysis, patients working at 2 years postoperatively but not at final follow-up were included in the RTW group so long as their reason for separation was not medically related as described in the study.

The study by Rensing et al[14] demonstrates the importance of evaluating not only the rate of RTW/RTS in patients undergoing DFO but also considering the level of the involved activities. This study reported the lowest rate of RTW at 42.1% compared with 88.5% and 91.3% in the other studies.[12,13,15] Because of the high physical demand of military duties, a lower rate of RTW after DFO is expected compared to professions that do not demand as much physical activity involving the knee. Unfortunately, few details on type of occupation or level of physical activity involved for work were provided in the other 2 studies analyzed for RTW data. The present study demonstrated that 41.6% to 100% of those individuals who did RTS returned to the same or greater activity level compared with their preoperative state. Specifically, Hoorntje et al[8] found that a greater proportion of their patients who were able to RTS participated in recreational rather than competitive sports. Presymptoms, 35% of patients were competitive/professional athletes compared with just 3% at final follow-up.[8] In contrast, Voleti et al[18] evaluated 13 patients who participated in sports at least 4 times a week, and all were able to return to the same frequency of sport participation. In addition, they were all able to return to their sport of choice, which included repetitive impact sports such as soccer, softball, running, and volleyball.[18] In conjunction with the Tegner and Marx Activity Scale data, the majority of patients treated with DFO are seemingly able to return to at least a recreational level of sport. A patient's age, type of sport, frequency of activity, and level of activity must all be considered when counseling patients and setting expectations on their probability of RTS after DFO. Additionally, factors such as the indications for DFO, angle of valgus deformity preoperatively, the amount of angular correction achieved, surgical approach, and concomitant procedures all must be considered when evaluating probability of RTS.

### Limitations

Several limitations of this review are worth noting. Across all 7 articles reviewed in this study, data were gathered on 194 patients, which is less than the number of patients available for similar systematic reviews on HTO.[5,9] Additionally, there are currently no validated or universally accepted outcome measures or methods to evaluate RTW or RTS. Since other patient-reported outcome measures are collected at defined postoperative intervals, RTW and RTS data may have been solicited at the same time, introducing recall bias if patients had already returned to work or sport before the collection date.

It is essential to recognize the vast heterogeneity in the patient populations and their preoperative profiles that can affect their rates of RTW/RTS. For example, there were wide ranges in the types of work or sports represented in each study. While there was some reporting of the types of sports among the studies, there was a lack of reporting on the type or level of work. Additionally, many studies, with the exception of Hoorntje et al,[8] did not report on preoperative levels of arthritis, which may have varied widely between patient populations and affected RTW/RTS. There was also heterogeneity in the amount of valgus deformity that was corrected for, which is an important consideration when discussing RTW/RTS after DFO. The severity of preoperative deformity can have an impact not only on baseline work/sports activity but also on the probability, timing, and activity level of patients returning to these activities. Furthermore, it is vital to recognize that DFO is often used to treat or is a part of the treatment of a vast heterogeneity of conditions. The severity of malalignment, additional chondral defects, meniscal deformities, and ligament injuries present challenges than isolated valgus deformities alone. Complex cases requiring additional procedures to treat these conditions may require longer recovery times. In addition to concomitant procedures, several patients expired symptomatic hardware complications requiring removal. In total, 72 patients underwent hardware removal, 65 of whom were from the study by Hoorntje et al.[8] Data reporting the time of hardware removal were available for 67 of these patients. The average time of hardware removal ranged from 9 to 24 months after the original procedure. Finally, as with any systematic review of the literature, there was heterogeneity in the method of reporting among studies that required extrapolation of the data. Future studies should attempt to establish a standardized method of evaluating RTS or RTW after orthopaedic procedures and incorporate a prospective design to minimize recall bias.

## CONCLUSION

Patients treated with DFO reported high rates of RTW and RTS, with most patients being able to return to recreational sport after surgery.

## ORCID ID

Deasn Wang https://orcid.org/0000-0002-3005-1154

## REFERENCES


1. Agarwalla A, Liu JN, Garcia GH, et al. Return to sport following isolated lateral opening wedge distal femoral osteotomy. *Cartilage*. Published online May 25, 2020. doi:10.1177/1947603520924775
2. Baron JE, Day MA, DeMik DE, Westermann RW, Wolf BR. Return to collegiate athletics after distal femoral osteotomy: a report of three cases and review of the literature. *Iowa Orthop J*. 2020;40:143-146.
3. Cote MP, Lubowitz JH, Rossi MJ, Brand JC. Reviews pooling heterogeneous, low-evidence, high-bias data result in incorrect conclusions: but heterogeneity is an opportunity to explore. *Arthroscopy*. 2018;34:3126-3128.
4. de Carvalho LH Jr, Temponi EF, Soares LF, Gonçalves MB, Costa LP. Physical activity after distal femur osteotomy for the treatment of lateral compartment knee osteoarthritis. *Knee Surg Sports Traumatol Arthrosc*. 2014;22:1607-1611.
5. Ekhtiari S, Haldane CE, de Sa D, Simunovic N, Musahl V, Ayeni OR. Return to work and sport following high tibial osteotomy: a systematic review. *J Bone Joint Surg Am*. 2016;98:1568-1577.
6. Frings J, Krause M, Akoto R, Wohlmuth P, Frosch KH. Combined distal femoral osteotomy (DFO) in genu valgum leads to reliable patellar stabilization and an improvement in knee function. *Knee Surg Sports Traumatol Arthrosc*. 2018;26:3572-3581.
7. Harris JD, Quatman CE, Manring MM, Siston RA, Flanigan DC. How to write a systematic review. *Am J Sports Med*. 2014;42:2761-2768.
8. Hoorntje A, van Ginneken BT, Kuijer P, et al. Eight respectively nine out of ten patients return to sport and work after distal femoral osteotomy. *Knee Surg Sports Traumatol Arthrosc*. 2019;27:2345-2353.
9. Kunze KN, Beletsky A, Hannon CP, et al. Return to work and sport after proximal tibial osteotomy and the effects of opening versus closing wedge techniques on adverse outcomes: a systematic review and meta-analysis. *Am J Sports Med*. 2020;48:2295-2304.
10. Marx RG, Stump TJ, Jones EC, Wickiewicz TL, Warren RF. Development and evaluation of an activity rating scale for disorders of the knee. *Am J Sports Med*. 2001;29:213-218.
11. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ*. 2009;339:b2535.
12. Puzzitiello RN, Liu JN, Garcia GH, et al. Return to sport and outcomes after concomitant lateral meniscal allograft transplant and distal femoral varus osteotomy. *Arthroscopy*. 2020;36:253-260.
13. Quirno M, Campbell KA, Singh B, et al. Distal femoral varus osteotomy for unloading valgus knee malalignment: a biomechanical analysis. *Knee Surg Sports Traumatol Arthrosc*. 2017;25:863-868.
14. Rensing N, Prabhakar G, Kusnezov N, Zarkadis NJ, Waterman BR, Pallis M. Distal femoral osteotomy in a young symptomatic population: outcomes correlate to concomitant pathology. *J Orthop*. 2019;16:283-288.
15. Slim K, Nini E, Forestier D, Kwiatkowski F, Panis Y, Chipponi J. Methodological Index for Non-Randomized Studies (MINORS): development and validation of a new instrument. *ANZ J Surg*. 2003;73:712-716.
16. Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. *Clin Orthop Relat Res*. 1985;198:43-49.
17. Thein R, Bronak S, Thein R, Haviv B. Distal femoral osteotomy for valgus arthritic knees. *J Orthop Sci*. 2012;17:745-749.
18. Voleti PB, Wu IT, Degen RM, Tetreault DM, Krych AJ, Williams RJ III. Successful return to sport following distal femoral varus osteotomy. *Cartilage*. 2019;10:19-25.
19. Wilson PL, Black SR, Ellis HB, Podeszwa DA. Distal femoral valgus and recurrent traumatic patellar instability: is an isolated varus producing distal femoral osteotomy a treatment option? *J Pediatr Orthop*. 2018;38:e162-e167.
20. Wylie JD, Scheiderer B, Obopilwe E, et al. The effect of lateral opening wedge distal femoral varus osteotomy on tibiofemoral contact mechanics through knee flexion. *Am J Sports Med*. 2018;46:3237-3244.


For article reuse guidelines, please visit SAGE's website at http://www.sagepub.com/journals-permissions.