Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

A Joint-Preserving Strategy Using Autologous Osteochondral En Bloc Transplantation and Distal Femoral Osteotomy for Extensive Osteonecrosis of the Lateral Femoral Condyle: A Case Report

Hiroki Yoshida
Nippon Medical School
Yasushi Oshima
y-oshima@nms.ac.jp

Nippon Medical School
Norishige Iizawa
Nippon Medical School
Tokifumi Majima
Nippon Medical School
Makoto Hirao
Nippon Medical School

Case Report

Keywords: Osteonecrosis of the knee, osteochondral transplantation, autograft, distal femoral osteotomy, joint preservation, case report

Posted Date: August 4th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10064606/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations:
No competing interests reported.

Figures are available in the Supplementary Files section.

Version of Record: A version of this preprint was published at BMC Musculoskeletal Disorders on October 9th, 2026. See the published version at https://doi.org/10.1186/s12891-026-10570-0.

Title

A Joint-Preserving Strategy Using Autologous Osteochondral En Bloc Transplantation and Distal Femoral Osteotomy for Extensive Osteonecrosis of the Lateral Femoral Condyle: A Case Report

Authors

Hiroki Yoshida, M.D. [1]

Yasushi Oshima, M.D., Ph. D. [1]

Norishige Iizawa, M.D., Ph. D.[1]

Tokifumi Majima, M.D., Ph. D.[1]

Makoto Hirao, M.D., Ph. D. [1]

Affiliations

[1]Department of Orthopaedic Surgery, Nippon Medical School 1-1-5, Sendagi, Bunkyo-ku, Tokyo, Japan

Corresponding Author Yasushi Oshima Department of Orthopaedic Surgery, Nippon Medical School 1-1-5, Sendagi, Bunkyo-ku, Tokyo, Japan Phone number: +81-3-3822-2131 Correspondence email: [y-oshima@nms.ac.jp]

Authors' contributions

HY: Conceptualization, Data curation, Writing - original draft, Investigation

YO: Methodology, Data curation, Supervision, Writing - review & editing, Investigation

NI: Investigation, Supervision

TM: Supervision

MH: Supervision, Writing - review & editing

Abstract

Background: Osteonecrosis of the lateral femoral condyle is a rare condition, and the optimal surgical management for extensive, deep lesions in young or active patients remains a matter of debate. Both unicompartmental knee arthroplasty and total knee arthroplasty raise concerns regarding implant longevity in this population, making joint-preserving surgical strategies desirable.

Case presentation: A 52-year-old man with a history of 10-year corticosteroid use was presented with pain on the lateral side of his left knee. Massive osteonecrosis of the lateral femoral condyle (approximately 25 × 30 × 15 mm), with concomitant mild valgus malalignment (hip-knee-ankle angle 4°) and a horizontal tear of the lateral meniscus was detected with the radiographical and computed tomography examinations. The patient underwent a combination of autologous osteochondral en bloc transplantation (OCET) of a mass graft which was harvested from the medial trochlea (approximately 20 × 25 × 18 mm) and fixed with four double-threaded screws, arthroscopic lateral meniscus repair, and medial closing-wedge distal femoral osteotomy (DFO) with a correction angle of 5°. At two years postoperatively, we confirmed solid union at both the

osteotomy and graft sites with no loss of alignment correction (femorotibial angle 176°, hip-knee-ankle angle -2°), and observed marked improvement in his knee pain, the visual analogue scale score, and all subscales of the Knee Injury and Osteoarthritis Outcome Score.

Conclusions: The combination of OCET and DFO were shown to be an effective and reliable joint-preserving treatment strategy for extensive and deep osteonecrosis of the lateral femoral condyle with concomitant valgus malalignment in young, active patients, while the long-term follow-up is necessary to evaluate durability.

Key words

Osteonecrosis of the knee, osteochondral transplantation, autograft, distal femoral osteotomy, joint preservation, case report

Introduction

Osteonecrosis of the knee was first described by Ahlbäck et al. in 1968 as a condition characterized by sudden-onset knee pain [1]. It predominantly affects adults over 50 years of age, presenting with severe nocturnal pain and pain on weight-bearing. The medial femoral condyle is most commonly occurred with more than 80% of cases, followed by the lateral femoral condyle, and the proximal tibia [2, 3]. It is rare, but occurs in bilateral knees [2, 3]. Osteonecrosis of the knee is classified as primary (idiopathic) or secondary. Primary osteonecrosis is thought to arise from microvascular injury associated with osteoporosis or subchondral insufficiency fractures, as well as from meniscal injury or instability that causes uneven load distribution and increased mechanical stress on the subchondral bone [2-6]. Secondary osteonecrosis, in contrast, is associated with systemic conditions such as corticosteroid use, alcohol abuse, and hemoglobinopathies; it may present bilateral knees and can extend into the metaphysis [1, 5, 7].

Radiographic staging of osteonecrosis of the knee has been proposed by Koshino et al. [8, 9], and is widely used to guide treatment decisions. Conservative treatment is considered effective when the necrotic lesion involves less than 40% of the condylar width; however, surgical intervention is recommended when necrosis

63 exceeds 40% or when it progressed to the secondary osteoarthritis, with periarticular osteotomy,
64 unicompartmental knee arthroplasty (UKA), and total knee arthroplasty (TKA) [5, 8-10].

65 Lateral femoral condyle osteonecrosis is substantially less common than medial condyle involvement, and
66 reports of treatment strategies for lateral condyle disease are limited, with no clear guidelines established.
67 Furthermore, in young or highly active patients, both UKA and TKA raise concerns regarding implant
68 longevity and the potential need for future revision surgery will be considered [11-15].

69 Recently, periarticular osteotomy has been performed for lateral femoral condyle osteonecrosis and lateral-
70 compartment osteoarthritis in younger patients, with favorable outcomes [16-22]. In addition, core
71 decompression and osteochondral plug transplantation (mosaicplasty) have been reported as effective
72 treatments targeting focal necrosis; however, extensive necrosis can be difficult to address with these
73 techniques alone [23-25]. For focal cartilage defects, microfracture is generally indicated for lesions smaller
74 than 2 cm^2, while mosaicplasty is considered effective for lesions of 2–4 cm^2; however, both techniques have
75 limitations for larger defects [3]. In our experience, the combination of osteochondral en bloc transplantation

(OCET) and opening-wedge high tibial osteotomy has yielded favorable outcomes for extensive osteonecrosis of the medial femoral condyle with varus malalignment.

Here we report a case of extensive and massive osteonecrosis of the lateral femoral condyle successfully treated with a combination of OCET and distal femoral osteotomy (DFO), with satisfactory short-term outcomes.

Case Presentation

A 52-year-old man who had been diagnosed with Crohn's disease at the age of 20 and received corticosteroid therapy for approximately 10 years. Although the disease was in remission without any symptoms, however, he suffered from left knee pain at the age of 50 and was referred to our institution.

On physical examination, the left knee was swollen with tenderness on the lateral joint line level, and a patellar ballottement sign was observed. The knee range of motion (ROM) was 0° in extension and 140° in flexion in both sides. The McMurray test was positive on the lateral side of the left knee. The visual analogue

89 scale (VAS) score was 80/100 mm, and the Knee Injury and Osteoarthritis Outcome Score (KOOS) was 60.7
90 in symptoms, 77.8 in pain, 92.6 in activities of daily living, 60.0 in sport/recreation, and 50.0 in quality of life.
91 Plain radiographs revealed osteonecrosis of the lateral femoral condyle classified as Koshino stage 2. The
92 lateral femorotibial angle (FTA) and the hip-knee-ankle (HKA) angle were 174° and 0° on the right, and
93 169° and 4° on the left, respectively [Fig. 1]. Computed tomography (CT) imaging demonstrated an
94 osteonecrotic lesion measuring approximately 25 × 30 in size and 15 mm in depth at the lateral femoral
95 condyle [Fig. 2]. Magnetic resonance imaging (MRI) revealed low intensity area on T1-weighted imaging
96 and a high intensity area on T2-weighted imaging at the same site, along with a horizontal tear of the lateral
97 meniscus involving the middle and posterior thirds of the meniscus. No significant abnormalities were
98 identified in the medial compartment [Fig. 3]. Based on these findings, the patient was diagnosed with
99 osteonecrosis of the lateral femoral condyle, lateral meniscus tear, and valgus knee deformity. As the
100 conservative treatment including medications and physical therapy over three months was not effective,
101 surgical treatment was performed.

Arthroscopic inspection of the both medial and lateral compartment revealed early degenerative changes with mild fissuring [Fig. 4a, b]. Arthroscopic surgery of the lateral meniscus was then performed using an all-inside suture technique with two stitches.

Following the arthroscopic procedures, a medial parapatellar arthrotomy was performed, and a medial closing-wedge DFO was performed with a correction angle of 5°, fixed using a TomoFix medial distal femur plate (DePuy Synthes, USA).

Autologous osteochondral reconstruction was subsequently performed. Intraoperative inspection revealed a cartilage defect measuring approximately 20 × 25 mm on the articular surface of the lateral femoral condyle [Fig. 4c]. An en bloc osteochondral autograft measuring approximately 20 × 25 × 18 mm was harvested from on the edge of the medial trochlea [Fig. 4d], and after thorough debridement of the necrotic tissue, the graft was transplanted into the defect and secured with four double-threaded screws [Fig. 4e]. The donor site was filled with the cancellous bone obtained from the resection of DFO and fixed with two cancellous screws.

Postoperatively, the knee ROM was restricted and partial weight-bearing were allowed for eight weeks, with full ROM and weight-bearing permitted at nine weeks postoperatively. Plain radiographs at three months demonstrated no screw loosening, hinge fracture, or correction loss with FTA of 176° and HKA angle of -2° [Fig. 5]. At two years postoperatively, full knee ROM was maintained. Plain radiographs and CT imaging confirmed solid union at both the osteotomy site and the graft site, indicating that the corrected lower extremity alignment was maintained [Fig. 6]. No progression of osteoarthritis on both medial and lateral tibiofemoral compartments, as well as the patellofemoral compartment, screw loosening at the graft site, or complications at the donor site was observed [Fig. 7]. The VAS score improved to be 0/100 mm, and all of KOOS items improved to be 89.3 in symptoms, 100 in pain, 100 in activity of daily living, 100 in sports/recreation, and 100 in quality of life.

Discussion

126 OCET and DFO were performed to the middle age patient with massive osteonecrosis of lateral femoral
127 condyle, and the short-term outcomes were sufficient.

128 Corticosteroid use is a well-recognized cause of secondary osteonecrosis of the knee. In the present case, the
129 contralateral knee showed neutral to slight varus alignment, whereas only the affected knee demonstrated
130 valgus deformity. This discrepancy suggests that corticosteroid-induced osteonecrosis or cartilage damage
131 may have initially occurred in the lateral femoral condyle, leading to progressive valgus malalignment and
132 subsequent lateral meniscus injury, which in turn further increased mechanical stress on the lateral
133 compartment and accelerated the progression of osteonecrosis. However, as the knee joints were not evaluated
134 prior to the onset of symptoms, the precise chronological sequence of these pathological changes could not be
135 determined.

136 Osteochondral transplantation is a joint-preserving procedure that enables articular surface reconstruction with
137 hyaline cartilage. Unlike TKA or UKA, which permanently limit high-impact activities, osteochondral
138 transplantation does not require long-term activity restrictions once graft incorporation is achieved, making it

particularly advantageous for young and physically active patients [24]. However, for extensive or deep osteonecrotic lesions, conventional osteochondral plug transplantation (i.e., mosaicplasty) using multiple small cylindrical grafts may be insufficient, as it inevitably leaves interfragmentary gaps filled with fibrocartilage. The OCET technique employed in this case utilizes a single, large osteochondral block, allowing complete coverage of a wide defect with a continuous hyaline cartilage surface and rigid screw fixation for immediate mechanical stability [26]. Furthermore, although DFO effectively reduces mechanical load on the lateral compartment, osteotomy alone does not address the damaged articular surface itself. In cases of extensive osteonecrosis, residual stress on the necrotic lesion may persist even after alignment correction, potentially leading to recurrent pain or recurrence of valgus deformity. OCET was therefore performed concomitantly to reconstruct the articular surface and minimize the risk of disease progression. Osteochondral allografting has demonstrated a survivorship of 89% at a mean follow-up of 5.6 years in femoral condyle osteonecrosis [26], and we believe that autologous en bloc transplantation offers comparable biological integration with the additional advantage of no immunological concerns.

The present patient also exhibited mild valgus malalignment; therefore, DFO was performed concomitantly to reduce mechanical load on the lateral compartment and protect the transplanted graft. DFO is a joint-preserving procedure that effectively unloads the lateral compartment in valgus knees, with favorable outcomes reported in young, active patients [19, 27, 28]. While postoperative limb alignment within ±3° of the mechanical axis is generally associated with good clinical outcomes, reoperation rates of approximately 10–40%, including conversion to TKA, have been reported at ten-year follow-up [15, 27, 29]. A recent systematic review also emphasized that TKA conversion after DFO is technically more demanding than primary TKA, primarily due to altered bone anatomy and ligamentous imbalance [29]. Considering the patient's age and activity level, we avoided overcorrection to prevent excessive loading of the medial compartment, while ensuring sufficient unloading of the lateral compartment to protect the transplanted graft. The postoperative alignment of -2° in HKA angle also preserved physiological bone morphology, which would facilitate soft-tissue balancing should future arthroplasty become necessary.

In this case, a combination of OCET, meniscal repair, and DFO was employed to address the complex pathology of lateral meniscus tear, valgus malalignment, and extensive osteonecrosis, yielding favorable short-term outcomes. Our goal was not only to delay arthroplasty but also to restore the articular surface and achieve a full return to activity without the activity restrictions associated with arthroplasty. In fact, the patient regained full sports and recreational function postoperatively (KOOS sport/recreation improving from 60 to 100). Although the alignment correction by DFO raises concern for potential progression of the pre-existing medial compartment osteoarthritis, this trade-off was considered acceptable given the functional benefit achieved. In addition, the possibility of future degenerative changes at the osteochondral donor site cannot be excluded. Although harvesting a large graft from the medial trochlea raises concerns regarding donor-site morbidity, our strategy of back-filling the defect with the autologous bone wedge derived from the DFO procedure effectively preserved the patellofemoral joint structure. At the two-year follow-up, no radiographic progression of osteoarthritis or clinical patellofemoral pain was observed, confirming the safety of this donor-site management. Long-term follow-up with careful monitoring of alignment changes and the progression of medial compartment osteoarthritis will be necessary.

Conclusion

We report a case of extensive, deep osteonecrosis of the lateral femoral condyle with concomitant mild valgus malalignment, treated successfully with a combination of OCET and DFO. Although the follow-up period remains limited to two years, favorable clinical outcomes were achieved.

List of abbreviations

UKA: unicompartmental knee arthroplasty

TKA: total knee arthroplasty

OCET: osteochondral en bloc transplantation

DFO: distal femoral osteotomy

ROM: range of motion

VAS: visual analogue scale

KOOS: Knee Injury and Osteoarthritis Outcome Score

FTA: femorotibial angle

HKA: hip-knee-ankle

CT: computed tomography

MRI: magnetic resonance imaging

Ethics approval and consent to participate

Ethical approval was not required for this case report in accordance with institutional guidelines. Written informed consent was obtained from the patient for participation in this study.

Clinical trial number

Not applicable.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report and the accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Competing interests

The authors declare that they have no competing interests related to this work.

Funding

This research did not receive any specific funding.

Authors' contributions

HY contributed to conceptualization, data curation, investigation, and writing the original draft. YO contributed to methodology, data curation, investigation, supervision, and manuscript review and editing. NI contributed to investigation and supervision. TM contributed to supervision. MH contributed to supervision and manuscript review and editing. All authors read and approved the final manuscript.

Acknowledgements

Not applicale.

References

[1] Sven Ahlbäck, Bauer H, Bohne WH. Spontaneous Osteonecrosis of the Knee. Arthritis and rheumatism. 1968 Dec 1;11(6):705–33.

https://doi.org/10.1002/art.1780110602

[2] Yamamoto T, Bullough PG. Spontaneous Osteonecrosis of the Knee: The Result of Subchondral Insufficiency Fracture. The Journal of Bone and Joint Surgery-American Volume. 2000 Jun;82(6):858–66.

https://doi.org/10.2106/00004623-200006000-00013

[3] Karim AR, Cherian JJ, Jauregui JJ, Pierce T, Mont Ma. Osteonecrosis of the knee: review. Annals of Translational Medicine. 2015 Jan;3(1):6.

http://dx.doi.org/10.3978/j.issn.2305-5839.2014.11.13.

[4] Mont MA, Rifai A, Baumgarten KM, Sheldon M, Hungerford DS. Total Knee Arthroplasty for Osteonecriosis. The Journal of Bone and Joint Surgery-American Volume. 2002 Apr;84(4):599–603.

https://doi.org/10.2106/00004623-200204000-00014

[5] Younis Z, Hamid MA, Devasia T, Abdullah F. Unicompartmental Knee Arthroplasty in Spontaneous Osteonecrosis of the Knee: A Narrative Review of Indications, Techniques, and Outcomes. Cureus. 2025 Oct 5;

https://doi.org/10.7759/cureus.93859

249 [6] Oshima Y, Watanabe N, Kajikawa Y, Yotsumoto T, Watanabe Y, Majima T. A case of subchondral
250 insufficiency fracture of the knee potentially caused by mediolateral knee laxity without structural
251 abnormalities. BMC Musculoskeletal Disorders. 2025 Feb 25;26(1).
252 https://doi.org/10.1186/s12891-025-08452-y
253
254 [7] Bruni D, Iacono F, Giovanni Francesco Raspugli, Stefano Zaffagnini, Marcacci M. Is Unicompartmental
255 Arthroplasty an Acceptable Option for Spontaneous Osteonecrosis of the Knee? Clinical Orthopaedics and
256 Related Research. 2012 May 1;470(5):1442–51.
257 https://doi.org/10.1007/s11999-012-2246-2
258
259 [8] Koshino T, Okamoto R, Takamura K, Tsuchiya K. Arthroscopy in spontaneous osteonecrosis of the knee.
260 The Orthopedic Clinic of North America. 1979 Jul;10(3):609-18.
261

262 [9] Koshino T. The treatment of spontaneous osteonecrosis of the knee by high tibial osteotomy with and
263 without bone-grafting or drilling of the lesion. The Journal of Bone and Joint Surgery American volume. 1982
264 Jan;64(1):47-58.

265

266 [10] Aglietti P, Insall J, Buzzi R, Deschamps G. Idiopathic osteonecrosis of the knee. Aetiology, prognosis and
267 treatment. The Journal of Bone and Joint Surgery British volume. 1983 Nov;65-B(5):588–97.
268 https://doi.org/10.1302/0301-620X.65B5.6643563

269

270 [11] Chalmers BP, Limberg AK, Athey AG, Perry KI, Pagnano MW, Abdel MP. Total knee arthroplasty after
271 distal femoral osteotomy long-term survivorship and clinical outcomes. 2019 Jun 1;101-B(6):660–6.
272 https://doi.org/10.1302/0301-620X.101B6.BJJ-2018-1334.R2.

273

274 [12] Tay ML, Young SW, Hooper GJ, Frampton CM. THE LIFETIME REVISION RISK OF
275 UNICOMPARTMENTAL KNEE ARTHROPLASTY. Orthopaedic Proceedings. 2023 Apr 11;105-
276 B(SUPP_8):114–4.

277

278 [13] Shah MD, Shah B, Desai SM, Jain A, Harshvardhan N, Shah MR. Lateral unicondylar knee arthroplasty
279 in osteonecrosis of lateral femoral condyle. International journal of health sciences. 2022 Jun 28;6662–70.
280 https://doi.org/10.53730/ijhs.v6nS4.9874

281

282 [14] Baron G, Ruidíaz S, Torres R. Perfect indications and how to avoid complications in lateral
283 unicompartmental knee arthroplasty. Journal of ISAKOS. 2024 Dec;9(6):100342.
284 https://doi.org/10.1016/j.jisako.2024.100342

285

286 [15] Yazdi H, Torkaman A, Sahrai R, Raygani MJ, Makhmalbaf A reza, Fathi M. Distal Femoral Varus
287 Osteotomy in Valgus Knee With Lateral Compartment Osteoarthritis: A Systematic Review. JAAOS: Global
288 Research and Reviews. 2025 Oct;9(10).
289 https://doi.org/10.5435/JAAOSGlobal-D-25-00121

290

291 [16] Forkel P, Achtnich A, Metzlaff S, Thore Zantop, Petersen W. Midterm results following medial closed
292 wedge distal femoral osteotomy stabilized with a locking internal fixation device. Knee Surgery Sports
293 Traumatology Arthroscopy. 2014 Mar 27;23(7):2061–7.
294 https://doi.org/10.1007/s00167-014-2953-1
295
296 [17] Yang T, Xue H, Ma T, Wen T, Xue L, Guan M, et al. Lateral Unicompartmental knee arthroplasty for a
297 secondary osteonecrosis of the lateral femoral condyle. A case report. BMC Musculoskeletal Disorders. 2020
298 Aug 31;21(1).
299 https://doi.org/10.1186/s12891-020-03585-8
300
301 [18] Nakamura R, Akiyama T, Takeuchi R, Nakayama H, Kondo E. Medial Closed Wedge Distal Femoral
302 Osteotomy Using a Novel Plate With an Optimal Compression System. Arthroscopy Techniques. 2021
303 Jun;10(6):e1497–504.
304 https://doi.org/10.1016/j.eats.2021.02.016
305

306 [19] Kaibara T, Kondo E, Matsuoka M, Iwasaki K, Onodera T, Momma D, et al. Medial closed-wedge distal
307 femoral osteotomy with local bone grafts for large collapsed steroid-induced osteonecrosis of the lateral
308 femoral condyle: A case report. Journal of Orthopaedic Science. 2023 Nov;28(6):1470–7.
309 https://doi.org/10.1016/j.jos.2021.06.016
310
311 [20] Haunschild ED, Gilat R, Aghogho E, Parvaresh KC, Wolfson T, Tauro T, et al. Functional outcomes and
312 survivorship of distal femoral osteotomy with cartilage restoration of the knee. Journal of Cartilage & Joint
313 Preservation. 2021 Mar;1(1):100004.
314 https://doi.org/10.1016/j.jcjp.2021.100004
315
316 [21] Piovan G, Farinelli L, Screpis D, Iacono V, Povegliano L, Bonomo M, et al. Distal femoral osteotomy
317 versus lateral unicompartmental arthroplasty for isolated lateral tibiofemoral osteoarthritis with intra-articular
318 and extra-articular deformity: a propensity score-matched analysis. Knee Surgery & Related Research. 2022
319 Jul 18;34(1).
320 https://doi.org/10.1186/s43019-022-00164-0

321

322 [22] Swindell HW, Kerzner B, Obioha OA, Fortier LM, Khan ZA, Dasari SP, et al. Osteochondral Allograft
323 Transplantation of the Lateral Femoral Condyle and Distal Femoral Osteotomy in the Setting of Failed
324 Osteochondritis Dissecans Fixation. Arthroscopy Techniques. 2022 Jul;11(7):e1301–10.
325 https://doi.org/10.1016/j.eats.2022.03.014

326

327 [23] Fujita N, Matsumoto T, Kubo S, Matsushita T, Ishida K, Hoshino Y, et al. Autogenous osteochondral
328 graft transplantation for steroid-induced osteonecrosis of the femoral condyle: A report of three young
329 patients. Sports, Medicine, Arthroscopy, Rehabilitation, Therapy & Technology. 2012 Apr 26;4(1):13.
330 https://doi.org/10.1186/1758-2555-4-13

331

332 [24] Ma J, Ren Y, Wang B, Yue D, Sun W, Wang W. Autologous Osteochondral Transplantation for Young
333 Patients with Postcollapse Osteonecrosis of the Knee: A Retrospective Cohort Study with an Average 7-Year
334 Follow-Up. CARTILAGE. 2021 Jun 17;13(1_suppl):1291S1297S.
335 https://doi.org/10.1177/19476035211023566

[25] Kumagai K, Yamada S, Nejima S, Sotozawa M, Inaba Y. Minimum 5-Year Outcomes of Osteochondral Autograft Transplantation with a Concomitant High Tibial Osteotomy for Spontaneous Osteonecrosis of the Knee with a Large Lesion. CARTILAGE. 2022 Jul;13(3):194760352211263. https://doi.org/10.1177/19476035221126341

[26] Bugbee W, Cavallo M, Giannini S. Osteochondral Allograft Transplantation in the Knee. Journal of Knee Surgery. 2012 May 15;25(02):109–16. https://doi.org/10.1055/s-0032-1313743

[27] Wylie JD, Jones DB, Hartley MK, Kapron AL, Krych AJ, Aoki SK, et al. Distal Femoral Osteotomy for the Valgus Knee: Medial Closing Wedge Versus Lateral Opening Wedge: A Systematic Review. 2016 Oct 1;32(10):2141–7. http://dx.doi.org/10.1016/j.arthro.2016.04.010

351 [28] Shivji FS, Foster A, Risebury MJ, Wilson AJ, Yasen SK. Ten-year survival rate of 89% after distal
352 femoral osteotomy surgery for lateral compartment osteoarthritis of the knee. Knee Surgery, Sports
353 Traumatology, Arthroscopy. 2020 Apr 13;
354 https://doi.org/10.1007/s00167-020-05988-5
355
356 [29] Luceri F, Jacopo Tamini, Paolo Ferrua, Ricci D, Cécile Batailler, Lustig S, et al. Total knee arthroplasty
357 after distal femoral osteotomy: a systematic review and current concepts. 2020 Sep 1;6:35–5.
358 https://doi.org/10.1051/sicotj/2020033
359

360 **Figure legends**

361 Fig. 1: Preoperative plain radiographs. (a) Anteroposterior view showing a radiolucent lesion in the lateral
362 femoral condyle (Koshino stage 2). (b) Lateral view. (c) Weight-bearing long-leg radiograph showing a hip-
363 knee-ankle (HKA) angle of 4° (valgus).

Fig. 2: Preoperative computed tomography (CT). (a) Coronal view. (b) Sagittal view showing an extensive osteonecrotic lesion (approx. 25 × 30 × 15 mm) in the lateral femoral condyle.

Fig. 3: Preoperative magnetic resonance imaging (MRI). (a) Coronal T2-weighted image. (b) Sagittal T2-weighted image demonstrating the necrotic lesion and a horizontal tear of the lateral meniscus.

Fig. 4: Intraoperative photographs. (a) Arthroscopic view of the medial compartment fissuring. (b) Arthroscopic view of the lateral compartment fissuring. (c) The osteonecrotic lesion on the lateral femoral condyle. (d) The osteochondral block harvested from the trochlea. (e) Final appearance of the transplanted graft secured with screws.

Fig. 5: Plain radiographs at three months postoperatively. (a) Anteroposterior view. (b) Lateral view. (c) Weight-bearing long-leg radiograph showing maintained alignment (FTA 176°, HKA angle -2°) with no screw loosening or hinge fracture.

Fig. 6: Plain radiographs at two years postoperatively. (a) Anteroposterior view. (b) Lateral view. (c) Weight-bearing long-leg radiograph showing maintained alignment (FTA 176°, HKA angle -2°).

377 Fig. 7. CT images at two years postoperatively. (a) Coronal view. (b) Sagittal view confirming solid union of

378 the graft and osteotomy site with no joint space narrowing at the donor site.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Figures.pdf