Clinical Communication

Osteochondral autograft transfer for the treatment of osteochondritis dissecans of the medial femoral condyle in dogs

N. Fitzpatrick; R. Yeadon; C. van Terheijden; T. J. Smith
Fitzpatrick Referrals, Halfway Lane, Eashing, Surrey, UK

Keywords
Osteochondral, autograft, osteochondritis dissecans, stifle, canine

Summary
Objective: To describe the clinical application of osteochondral autograft transfer procedure for the treatment of osteochondritis dissecans (OCD) of the canine medial femoral condyle and to report clinical and force plate outcomes.

Methods: Osteochondral autograft transfer (OATS™; Arthrex, Naples FL, USA) instrumentation was employed in six stifle joints of five dogs. Clinical examination was performed preoperatively and at two to three weeks, six to eight weeks, 12–18 weeks and at >22 months postoperatively. Radiography and arthroscopy were performed preoperatively and 12–18 weeks postoperatively. The follow-up examinations performed at 22 to 56 months included radiography, questionnaire completion with the owner, and force plate gait evaluation.

Results: Articular surface reconstruction was radiographically (for 6 stifle joints) and arthroscopically (for 5 stifle joints) maintained at 12–18 weeks. Subjectively-assessed lameness resolved in five out of six stifles by the 12 to 18 week reassessment. Morbidity included lateral patellar luxation at seven weeks and cranial cruciate ligament rupture at 11 months postoperatively. At the >22 month re-evaluation examination, subjectively-assessed lameness and signs of discomfort were minimal. Owner perceptions of outcome were positive; force plate assessment of gait indicated that weight bearing on three out of six OAT implanted limbs was less than the contralateral limb, but these comparisons were not evaluated statistically. A progression in the development of osteophytes was radiographically evident. Clinical significance: The OAT procedure can reconstruct medial femoral condyle OCD defects in dogs. Long-term lameness and progressive osteophytosis may occur but can be associated with other pathology such as cruciate ligament insufficiency.

Materials and methods
Clinical, radiographic and arthroscopic records of all dogs undergoing OAT for OCD of the femoral condyle at Fitzpatrick Referrals (Eashing, Surrey, UK) between July 2004 and September 2008 were retrospectively reviewed. Written owner consent was obtained to perform OAT, and to perform second-look arthroscopy as part of the postoperative care and monitoring of outcome protocol for each patient. Study inclusion criteria included:

1. Osteochondral autograft transfer for an OCD lesion of the medial femoral condyle.

Correspondence to:
Noel Fitzpatrick, DUniv, MVB, CertSAO, CertVR
Fitzpatrick Referrals
Halfway Lane
Eashing, Surrey GU7 2QQ
United Kingdom
Phone: +44 1483 423 761
E-mail: noel@fitzpatrickreferrals.co.uk

Introduction

Osteochondritis dissecans (OCD) is an important developmental disease of the stifle in young large-to-giant breed dogs (1–5). The lateral condyle of the femur is most commonly affected although the medial femoral condyle may occasionally be affected (3, 5, 6).

Osteochondral autograft transfer (OAT) procedures, which involve transplantation of one or several cylindrical cores of relatively healthy articular cartilage and underlying subchondral bone from a region of limited load bearing to a symptomatic osteochondral defect, have recently been described as a treatment option for OCD in the canine stifle, elbow and shoulder (5, 7, 8–10). These reports follow experimental studies which established viability of OAT procedures in the canine stifle and hock (11–13). However, clinical reports to date have only documented management of OCD lesions of the lateral femoral condyle (5, 7, 8).

Clinical outcomes following OAT procedures for OCD of the canine lateral femoral condyle have documented consistent improvements in lameness and quality of life in a small group of dogs (5). However there was a relatively high incidence of persistent lameness six to eight weeks postoperatively according to subjective clinician assessments, as well as persistent signs of pain or lameness six to 15 months postoperatively according to the subjective owner assessments.

The objectives of this study were to document the use of OAT procedures for management of naturally-occurring OCD of the medial femoral condyle in dogs, and to report short- and long-term subjective and force plate outcome measures.

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2. Complete clinical, radiographic and arthroscopic records to a minimum of 12 months postoperatively.
3. Second-look arthroscopy performed at 12–18 weeks postoperatively.
4. Force plate gait assessment performed at a minimum of 22 months postoperatively.

Clinical case selection criteria for performance of OAT included presence of lameness attributable to stifte pain, and presence of a femoral condyle OCD lesion of >5 mm diameter as assessed radiographically, arthroscopically or at arthrotomy. Three dogs (4 stifles) with lesions of the medial femoral condyle <5 mm diameter and managed by traditional debridement and subchondral drilling were identified and excluded from further study. Six dogs (9 stifles) managed by OAT for OCD of the lateral femoral condyle during this period were also identified and excluded from further study.

Surgical technique

Osteochondral autograft transfer system instrumentation was employed. Arthroscopy and OAT procedures were performed immediately following preoperative arthroscopic assessment in all dogs. A limited medial parapatellar approach from the level of the distal third of the patella to the tibial tuberosity was made, and extended further proximally if required for donor osteochondral core harvesting. Stifle flexion, infrapatellar fat pad resection, and soft tissue retraction using Gelpi self-retaining retractors were employed to optimize exposure and facilitate perpendicular access to the OCD lesion (Fig. 1A). Thereafter, OAT procedures were performed principally as described by Cook et al. (5). In contrast to the previously reported technique, we opted to create recipient sockets using the OATS™ cannulated drill bit (Fig. 1D) prior to harvesting of donor osteochondral core harvesting. Stifle flexion, infrapatellar fat pad resection, and soft tissue retraction using Gelpi self-retaining retractors were employed to optimize exposure and facilitate perpendicular access to the OCD lesion (Fig. 1A). Thereafter, OAT procedures were performed principally as described by Cook et al. (5). In contrast to the previously reported technique, we opted to create recipient sockets using the OATS™ cannulated drill bit (Fig. 1D) prior to harvesting of donor osteochondral cores (Fig. 1B) with the OATS™ donor trephine.

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Fig. 1 A-E Intra-operative photographs of an eight-month-old Labrador Retriever, showing typical appearance of medial femoral condyle lesion via a medial parapatellar arthrotomy (A), appearance of a donor osteochondral core (B), and lesion resurfacing using two osteochondral cores (C-E). The first donor core (C) is inserted before creating the second recipient socket (D) and insertion of the second core (E). F) Arthroscopic appearance of the same case at 14 weeks postoperatively. The grafted cartilage surface (top and centre of image) is well conformed to the articular contour but demarcated by a small cleft between donor and recipient cartilage. Cartilage cover is complete and gross appearance is consistent with healthy hyaline cartilage. G, H) Appearance of the same case at arthrotomy at the time of tibial plateau levelling osteotomy 11 months postoperatively for cranial cruciate ligament rupture. The donor core is visible with a persistent cleft between the donor and recipient articular surfaces (G). Surface appearance is consistent with healthy hyaline cartilage (G). There is near-complete infilling of medi- al trochlear ridge donor sites with grossly resilient soft tissue and small adhesions of adjacent synovium (H).
Donor cores were harvested either from the abaxial aspect of the proximal medial trochlear ridge (Fig. 2A), or from the plateau intersect of condyle and trochlea (Fig. 2B) (9). We did not use the clear OATS™ graft delivery tube because it was considered to limit direct observation of the core surface contour, potentially compromising topographical-matching between recipient site and donor core (5). All cores were inserted by direct manual technique (Fig. 1C and 1E).

**Perioperative management**

Analgesia consisted of the administration of methadoneb (0.2 mg/kg IM q4–6h PRN) or buprenorphinec (0.02 mg/kg IM q8–12h PRN) for the first 24–48 hours. Meloxicamd (0.2 mg/kg s/c) was administered at the time of induction of anaesthesia, and continued at the dosage of 0.1 mg/kg PO q24h for 21–48 days dependent on owner-assessments of lameness or signs of discomfort. A self-adhesive wound dressinge was applied to the surgical site for two days postoperatively. Enforcement of cage rest for six weeks and progressively increasing duration of leash-only walking (to a maximum of 40 minutes per walk four times daily) until 12 weeks postoperatively were recommended.

**Clinical examination and owner anamnesis**

Historical and signalment information was recorded, including severity and duration of lameness, previous management options and corresponding patient responses. Clinical examinations were performed by author 1 (NF) preoperatively, and then at 2–3 weeks, 6–8 weeks, 12–18 weeks and more than 22 months postoperatively. Each examination included physical examination, subjective evaluation of lameness, and subjective assessment of signs of discomfort on joint manipulation. Lameness was graded according to a five-point ordinal scale (Grade 0 = no lameness; Grade 1 = mild intermittent lameness; Grade 2 = persistent mild weight-bearing lameness; Grade 3 = persistent moderate weight-bearing lameness; Grade 4 = persistent severe weight-bearing lameness; Grade 5 = Persistent or intermittent non-weight-bearing lameness). Signs of discomfort on joint manipulation were subjectively scored as absent, mild, moderate or severe.

**Radiology**

Radiographic assessment was performed preoperatively, 12–18 weeks postoperatively, and more than 22 months postoperatively under routine deep sedation or general anaesthesia, and included mediolateral and caudo-cranial projections of affected stifle joints. Particular attention was paid to subchondral bone contour and trabecular bone pattern at the graft site and subjective observations recorded. The size of osteophytes was scored by Author 2 (RY) using an ordinal scale (Grade 0 = lack of osteophytes; Grade 1 = osteophytes <2 mm height in any location; Grade 2 = osteophytes 2–5 mm height in any location; Grade 3 = osteophytes >5 mm height in any location) based on a previously described grading scheme (9).

**Arthroscopy**

Preoperative arthroscopic assessment, using standard medial portal placement with a 30° forward-facing 2.7 mm arthroscopef connected to a video camera and image recording device, confirmed presence, location and approximate size of the OCD lesion (14). Findings recorded included anatomical location of the OCD lesion, subjective measures of synovitis and variation in indentational stiffness of articular cartilage as subjectively determined by palpation using a fine arthroscopic probe. Osteochondritis dissecans of the medial femoral condyle was confirmed as the sole pathology for all cases. Second-look arthroscopy of the recipient site was performed under general anaesthesia at the 12–18 week re-examination following the same protocol as preoperatively, but with particular attention to the graft site and immediately contiguous cartilage. Intra-articular graft donor sites were also examined. Descriptive findings were recorded.

>22 month reassessment

In addition to the clinical and radiographic reassessment as described, at the >22 month postoperative reassessment, an owner questionnaire featuring current assessments of limb function and comfort, and satisfaction with the procedure was conducted by direct interview (Appendix 1: Available online at www.vcot-online.com).
Force plate data were collected using a biomechanical platform embedded in a 10 meter runway and specialized computer software. Dogs were allowed to explore the environment before measurements were performed. Five valid trials were obtained for each pelvic limb of dogs at velocity 0.8–1.3 m/s. Velocity was measured using two photoelectric cells placed one meter apart. Peak vertical force (PVF), vertical impulse (VI) and falling slope (FS) were recorded for each trial. A mean value for each parameter for each limb was calculated from the five trials and used for subsequent calculations. Peak vertical force values were expressed as a percent of body weight (%BW) and VI as a percent of body weight times seconds (%BW x sec). Falling slope values were expressed as a percent of body weight divided by seconds (%BW / sec). A symmetry-index (SI) for PVF was calculated as: SI = 200 [(PVF1–PVF2) / (PVF1+PVF2)] for each dog, where PVF1 was the higher, and PVF2 the lower value. A symmetry index of zero percent would indicate perfect symmetry with this calculation. Based on the results of a previous study, an SI of PVF >9% was considered indicative of lameness (15).

**Statistical analysis**

Statistical analysis of available data was performed using commercially available software. Descriptive statistics were calculated for signalment, quantitative pre- and postoperative clinical data, technical surgical data, and force plate data. Further analysis was precluded by a lack of statistical power.

**Results**

Five dogs (6 joints) were included. One dog underwent single-session bilateral surgical procedures. One dog had a small (<4 mm) OCD lesion of the contralateral medial femoral condyle which was managed by traditional arthroscopic debridement alone.

**Signalment and preoperative clinical findings**

All dogs were Labrador Retrievers. Age at presentation ranged from six to 10 months (mean 8.2 months; median 8 months). Mean body weight (BW) was 24.2 ± 6.09 kg (range 16.7 – 31.0 kg). All dogs were male; one had been neutered at the time of presentation.

Duration of lameness preoperatively ranged from four to 12 weeks (mean 7.7 weeks; median 6 weeks). Subjective severity of lameness was Grade 4 in one out of six stifles, Grade 3 in three out of six stifles, and Grade 2 in two out of six stifles. Moderate (n = 4/6) or severe (n = 2/6) signs of pain were documented on stifle manipulation for all affected joints preoperatively. Three out of five dogs had been treated with non-steroidal anti-inflammatory drugs prior to assessment. All dogs had undergone periods of exercise restriction of one week or longer preoperatively (range 1–10 weeks).

**Radiographic and arthroscopic findings and surgical details**

Preoperative radiography of all stifles demonstrated a ‘scalloped’ subchondral bone defect of the medial femoral condylar surface. This was confirmed arthroscopically to represent an OCD lesion identified as a partially or fully dissected cartilage flap with subchondral bone exposure. No other primary disease processes were radiographically or arthroscopically identified. Osteophytosis was scored as Grade 0 (4 stifles) or Grade 1 (2 stifles).

Maximal lesion dimension ranged from 8.0 mm to 17.0 mm (mean 10.2 mm; median 9.0 mm). Transfer of two donor cores to cover the osteochondral defect was performed in one out of six stifles; a single core was used in five out of six stifles. Complete cover of the osteochondral defect by the donor core(s) was achieved in all cases. Donor core length ranged from 7.0 – 12.0 mm (mean 9.3 mm; median 9.0 mm). Cores were harvested from the abaxial medial trochlear ridge (n = 4 stifles, 5 cores) or the medial plateau intersect of condyle and trochlea (n = 2 stifles, 2 cores).
rate reconstruction of articular contour at the OCD defect was considered to have been achieved in all cases.

Complications

No significant intraoperative complications occurred. Minor haemorrhage from the donor core site occurred in most cases but was readily controlled by packing the site with a moistened sterile gauze swab for one to three minutes prior to lavage and closure. Lateral patellar luxation was identified seven weeks postoperatively in one stifle and was attributed to breakdown of the surgical closure of the medial arthrotomy, and excessive fibrous tissue reaction at the associated suture line. This complication resolved after surgical debridement and revision of the soft tissue closure.

Cranial cruciate ligament rupture occurred 11 months postoperatively in one stifle and was managed by tibial plateau levelling osteotomy. Resolution of subjectively-assessed lameness and stifle discomfort occurred within what was arbitrarily considered to be an appropriate timescale for this procedure. Arthrotomy at the time of tibial plateau levelling osteotomy demonstrated near-complete infilling of donor sites on the medial trochlear ridge with grossly resilient soft tissue with superficial appearance consistent with fibrous tissue, and small adhesions of adjacent synovium to the donor sites. The donor core remained visible at the recipient site with a persistent cleft between the respective articular surfaces, but both had a gross surface appearance consistent with healthy hyaline cartilage. No meniscal injury or other primary disease process was identified on direct inspection. No direct link could be established between the OAT procedure and the ligamentous injury (such as synovial adhesions in the region of the cruciate ligaments or excessive intercondylar osteophytes). Postoperative clinical outcome

All dogs were weight-bearing on surgically treated limbs within 48 hours of surgery. Grade of subjectively assessed lameness decreased throughout the study period after two to three weeks postoperatively for all dogs. Discomfort on stifle manipulation was considered moderate for all stifles at the two to three week postoperative assessment. Discomfort on stifle manipulation was considered mild for three out of six stifles, and absent for three out of six stifles at the six to eight week postoperative reassessment. Five out of six stifles were subjectively considered sound (lameness grade 0/5) at the 12 to 18 week postoperative reassessment, the only exception being the case of patellar luxation, and discomfort on stifle manipulation was considered absent for all stifles at this time.

Fig. 4  Medio-lateral (A, C, E, G) and caudo-cranial (B, D, F, H) radiographs of 10-month-old Labrador Retriever taken immediately preoperatively (A and B), immediately postoperatively (C and D), 16 weeks postoperatively (E, F), and 48 months postoperatively (G, H). Radiographic subchondral contour has improved immediately postoperatively (C, D) compared with preoperatively (A, B), with replacement of the scalloped concave osteochondritis dissecans lesion with a smooth convex subchondral bone contour. This appearance is maintained at 16 weeks (E, F), but osteophytosis has progressed to Grade 1. Absence of radiolucency at the donor graft sites at 16 weeks indicates tissue infilling. Subchondral contour at the medial femoral condyle recipient site has been grossly maintained 48 months postoperatively (G, H) but osteophytosis has progressed to Grade 3.
Postoperative radiography

Preoperative radiography revealed a scalloped concave subchondral profile of the OCD lesion, whereas immediate postoperative radiography showed that grafting had produced a smooth, convex subchondral bone contour which was continuous and congruent with the adjacent recipient articular surface (Fig. 1F). In all cases, this appearance was maintained at 12 to 18 weeks (Fig. 4E and 4F). At the 12 to 18 week radiography, continuity of trabecular pattern and similar radiographic opacity of transplanted and recipient cancellous bone were observed at all recipient sites. Donor sites did not manifest radiolucency at bone were observed at all recipient sites.

12–18 week postoperative arthroscopy

Five out of six stifles were considered to have a good outcome according to our arthroscopic assessment at 12–18 weeks postoperatively (median 14 weeks). The grafted cartilage surface was palpably resilient and well conformed to the articular contour. Cartilage cover of the graft was complete and gross appearance was consistent with healthy hyaline cartilage (Fig. 1F). The graft was demarcated by a small cleft between donor and recipient cartilage, consistent with absence of cartilage integration (Fig. 1F).

One of six stifles (of the dog that had bilateral surgery) was considered to have a fair arthoscopic outcome due to subsidence of the donor core within the recipient socket by approximately 0.5 mm as determined arthroscopically. The cleft between the recipient cartilage and donor core showed proliferative fibrillar strands with a gross appearance of fibrocartilage which were partially overlying the surface of the donor core. There was not any sign of lameness according to our subjective assessment at this time, so no further action was taken.

All donor sites remained clearly visible, but all had partial infilling with a visual surface appearance consistent with fibrous tissue. Adhesions of adjacent synovium to the donor site were identified in two of six stifles (Fig. 4E and 4F) or Grade 2 (3 stifles).

>22 month postoperative reassessment

All dogs were available for reassessment at a mean of 44.4 months postoperatively (range 22–56 months). Mean BW at time of reassessment was 36.1 kg (range 19.6–50.8 kg) with the heaviest being markedly obese (body condition score 8/9). Three of five dogs were currently receiving daily dietary supplementation with a glucosamine and chondroitin sulfate nutraceutical product. No dog was receiving non-steroidal anti-inflammatory medication or other prescription medications.

Owner assessment

Owner questionnaire (Appendix 1–available online at www.vcot-online.com) assessment confirmed that all dogs manifested signs of discomfort preoperatively. Four dogs were reported as having moderate current activity levels while one dog was reported as having a high current activity level. Three dogs had improved by one grade of activity level compared with preoperatively, while two dogs were judged to have a similar activity level compared with preoperatively. One dog was considered to have unilateral persistent lameness scored at Grade 2, and stifle discomfort scored at Grade 1 (the dog that had bilateral surgery, with lameness affecting the limb with previously-identified core subsidence). Two further dogs were assessed as having intermittent lameness and discomfort (Grade 1 for both dogs) specified as only occurring following heavy exercise. Two dogs were reported to exhibit no lameness or discomfort (Grade 0 for both dogs). All owners considered themselves ‘very satisfied’ with the surgery.

Table 1  Force plate data for five dogs with osteochondritis dissecans treated by osteochondral autograft transfer in six stifle joints. The results for each limb are reported as mean ± standard error of five valid trials.

<table>
<thead>
<tr>
<th>Dog</th>
<th>Body weight (kg)</th>
<th>Time to postoperative reassessment (months)</th>
<th>Peak vertical force (% body weight; ± SD)</th>
<th>Symmetry index of PVF (%)</th>
<th>Vertical impulse (% body weight x seconds; ± SD)</th>
<th>Falling slope (% body weight / seconds; ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>OAT limb</td>
<td>Non-OAT limb</td>
<td>OAT limb</td>
<td>Non-OAT limb</td>
</tr>
<tr>
<td>1</td>
<td>50.8</td>
<td>45</td>
<td>44.3 ± 3.26</td>
<td>38.6* ± 2.15</td>
<td>13.82</td>
<td>11.0 ± 1.24</td>
</tr>
<tr>
<td>2</td>
<td>40.7</td>
<td>56</td>
<td>59.2 ± 9.70</td>
<td>51.9* ± 2.85</td>
<td>13.25</td>
<td>10.0 ± 1.62</td>
</tr>
<tr>
<td>3</td>
<td>33.2</td>
<td>22</td>
<td>47.0* ± 4.3</td>
<td>53.5 ± 4.15</td>
<td>12.98</td>
<td>9.7* ± 0.99</td>
</tr>
<tr>
<td>4</td>
<td>19.6</td>
<td>51</td>
<td>47.0* ± 9.65</td>
<td>55.0 ± 6.40</td>
<td>14.36</td>
<td>10.3* ± 2.17</td>
</tr>
<tr>
<td>5</td>
<td>36.2</td>
<td>48</td>
<td>53.1 ± 3.04</td>
<td>54.5 ± 2.68</td>
<td>2.3</td>
<td>9.9 ± 1.80</td>
</tr>
</tbody>
</table>

Key: * Dog 1 underwent bilateral osteochondral autograft transfer (OAT) procedures. †Dog 2 underwent conventional non-AOT management of contralateral osteochondritis dissecans (OCD). ‡Dog 3 subsequently underwent surgery for cranial cruciate ligament insufficiency on the OAT treated limb. §Dog 4 subsequently underwent surgery for lateral patellar luxation on the OAT treated limb.
Clinical outcome

On clinical examination, only one limb (the dog that underwent bilateral surgery with previously-identified core sub-
sidence) was considered to be lame (Grade 2) by subjective assessment and had signs of mild discomfort on joint manipulation. The other five stifles were considered not lame (Grade 0) on subjective assessment and signs of discomfort were considered absent on stifle manipulation.

Long-term radiography

Long-term radiography (Fig. 4H and 4I) of all stifles revealed maintenance of sub-
chondral contour similar to that on the <18 week postoperative radiographs. Progression of osteophyte development compared with 12–18 weeks postoperatively was identified in all dogs, and was scored as Grade 2 (4 stifles) and Grade 3 (2 stifles; Fig. 4H and 4I) with osteophytes being identified at multiple locations for all joints.

Long-term force-plate

The individual force plate data for the five dogs in the study are reported in Table 1. Although the force plate data were not sub-
jected to statistical analysis, the individual values indicate that OCD of the stifle was often associated with some degree of lame-
ness. However, interpretation of the data is not possible because two dogs had bilateral stifle OCD and two other dogs developed a second problem after the OAT procedure, namely lateral patellar luxation and cranial cruciate ligament rupture.

Discussion

Clinical application of medial femoral condyle OAT was considered technically straightforward and consistent with both the authors’ personal experience and previous reports of application at the lateral femoral condyle (5, 7, 8). Accurate recon-
struction of the articular surface was achieved in all cases at the time of surgery and was radiographically (n = 6/6) and arthroscopically (n = 5/6) maintained at the 12 to 18 week reassessment. Resolution of subjectively-assessed lameness and signs of discomfort were documented in two of six stifles at the six to eight week reassess-
ment, and in five of six stifles at the 12–18 week reassessment. At the 22–56 month postoperative reassessment, lameness was minimal by subjective clinician assessment and owner perceptions of outcome were positive, but force plate assessment revealed lameness of three of six limbs. Radiographic progression of osteophyte develop-
ment was a feature of all joints.

We acknowledge a number of important limitations of this study. The outcome measures were largely subjective in nature, as was the long-term owner questionnaire which was neither standardized nor valid-
dated. Subjective evaluation of lameness was considered particularly challenging given the relatively high incidence of bilateral disease or co-morbidities (5/6 stifles). This concern was supported by the >22 month postoperative force plate data which objectively documented gait abnormality in some cases in the absence of visually-detected lameness, in support of a previous study (16). All postoperative clinical and arthroscopic evaluations were performed by the primary surgeon (author 1; NF) who was aware of previous clinical data, so some bias affecting subjective assessments was unavoidable. The lack of histological, anat-
omic, magnetic resonance imaging or biomechanical data to support the clinical, radiographic and arthroscopic outcomes, and the small number of cases were further limitations.

An additional limitation of the study was the nature of our force plate gait evalu-
ation, which was performed at a walk rather than a trot, and across a small but potentially significant range of velocities which may predispose to inaccuracies (15). Furthermore, it was performed on a simple single force plate system and with limited control over gait acceleration within each trial. While these limitations may compro-
mise the conclusions that can be drawn from this data, this system was used as it was the authors’ routine protocol at the time of the study, and had undergone in-
house data validation. Use of SI of PVF cal-
culations to extrapolate contralateral limbs as controls may go some way toward miti-
gating these limitations in our data inter-
pretation, although caution is still war-
nanted.

A previously described technique for OAT of the canine stifle described harvesting of donor osteochondral cores prior to creation of corresponding recipient sockets (5). In contrast, we elected to create recipi-
ent sockets before harvesting donor osteo-
chondral cores to allow assessment of sub-
chondral bone quality during reaming, with the option to ‘upsize’ the core diam-
eter if bone quality appeared poor, and was a result of the authors’ experience of the OAT technique at other anatomic sites. A potential hazard of this procedure se-
quence is that if the donor osteochondral core is damaged or fractures at a shorter length than intended during extraction (this complication was reported in a pre-
vious study), then core salvage by implan-
tation in multiple pieces may be necessi-
tated (9). We minimised the risk of this by harvesting donor cores 2–3 mm longer than required, and subsequently trimming them to the measured socket length (Fig. 1B) using a scalpel blade as required.

The 12 to 18 week postoperative arthro-
scopic evaluation allowed direct exami-
nation of transplanted articular cartilage in a minimally-invasive manner. Graft sub-
sidence was arthroscopically identified in one of six stifles, but at that time was associ-
ated with a positive subjectively assessed clinical outcome, so no additional inter-
vention was undertaken. However, long-
term clinical and force-plate evaluation of this limb documented persistent lameness. While the poor clinical outcome in this case could not be definitively associated with the sub-optimal arthroscopic outcome at 12–18 weeks since sequential arthroscopic or additional outcomes measures were un-
available, it was of note that no other pri-
mary disease processes were identified in this dog, inferring that graft subsidence was a possible explanation for the poor out-
come.

Objective force-plate data documented persistent lameness in two further stifles in spite of positive subjective clinical out-
comes, highlighting the inaccuracy of such subjective assessments as previously re-
ported (17). Both joints had undergone subsequent surgeries for management of
lateral patellar luxation (as a complication of the initial OAT procedure) and cranial cruciate ligament rupture respectively. Only one dog was not affected by contralateral disease, co-morbidity or underwent secondary surgical intervention, and in that dog, objective force plate data and subjective evaluation supported absence of lameness at long-term reassessment (48 months postoperatively). It remains unclear whether persistent lameness was exclusively a feature of major complication or co-morbidity due to the small number of cases in this study, but the presence of long-term lameness in itself may be prognostically useful information since morbidity and co-morbidity are an inevitable feature in any clinical case series. The finding of persistent lameness supports the findings of Cook et al. for OAT of the lateral femoral condyle, and earlier studies describing conventional osteochondral debridement techniques with or without subchondral drilling for OCD of the canine femoral condyle, suggesting that long-term prognosis must be cautious in spite of treatment modality (1–5). Similarly, progressive osteophyte development was documented at the 22–56 month reassessment, and supports previous reports that osteoarthritis progresses in spite of treatment modality (2, 4).

A potential explanation for the ongoing degeneration and frequent persistent lameness reported is the inevitable anatomical and biomechanical variations between donor and recipient sites, both of which have been previously documented (18). While anatomic reconstruction was confirmed intra-operatively in all cases, variation in cartilage thickness between donor and recipient sites would result in an effective step in the subchondral bone contour, and could predispose to premature cartilage degeneration, even when the cartilage surface is considered congruent. No step was identified radiographically in this study, but advanced imaging techniques such as computed tomography might have been useful to document and quantify any subchondral incongruity.

In one case affected by cranial cruciate ligament disease 11 months postoperatively, no direct link could be established between the OAT procedure and the liga-mentous injury, but an indirect association such as initiation of an inflammatory cascade by either the disease process or the OAT procedure, contributing to progressive ligamentous degeneration and thereby predisposing to ligamentous failure, could not be excluded.

As a by-product of this study, the authors observed that medial femoral condyle OCD lesions were identified exclusively in Labrador Retrievers, while contemporaneous cases of lateral femoral condyle OCD managed by OAT excluded from this study were identified exclusively in non-Labrador breeds (German Shepherd Dog, Great Dane, Dalmatian, Flat Coated Retriever, British Inuit). No known familial relationship between the Labradors in this study was recorded. This finding has not been reported in other studies and may represent coincidence, an unusual geographic feature or an unrecorded familial trait.

Osteochondral autograft transfer procedures are a viable treatment modality for OCD lesions of the canine medial femoral condyle. Accurate reconstruction of articular contour can be achieved. Short-term lameness is effectively ameliorated and may be resolved based on subjective assessments. Lameness, as documented by objective force plate analysis and progression of osteophytosis, may be anticipated in the long-term, although the role of complications and co-morbidities in this finding requires elucidation. Superior outcomes of OAT procedures compared with microfracture in the human knee have been described and this is a potential area of further study (16). Further investigation including cohort studies prospectively comparing OAT and debridement for treatment of OCD lesions are warranted.

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Conflict of interest
None declared.

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