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Short-term outcomes of trochlear recession surgery combined with "Watermelon" autograft for treatment of canine medial patellar luxation: a case series

[*Resultados a curto prazo da cirurgia de recessão trocolear combinada com o auto-enxerto "Melancia" para tratamento da luxação patelar medial canina: uma série de casos*]

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ABSTRACT

The aim of this study was to present a novel surgical method for correction of medial patellar luxation in small-breed dogs with trochlear dysplasia and marked hypoplasia of the medial femoral condyle. The "Watermelon" approach was applied together with trochlear wedge recession or trochlear block recession and consisted in increasing the height of the medial condyle with an osteochondral autograft resembling a watermelon slice, placed into an additional slot in the medial femoral condyle to prevent the postoperative reluxation of the patella. The study cohort included 19 dogs (25 joints) from small breeds (Pinscher, Pomeranian, and Chihuahua) with second-grade medial patellar luxation. Fourteen joints were submitted to wedge recession surgery combined with "Watermelon" grafting, and 11 joints: to block recession surgery with "Watermelon" grafting. The sulcus-deepening trochleoplasty combined with "Watermelon" grafting was clinically successful and with low percentage of minor postoperative complications. The mean duration of anesthesia was significantly longer for block recession combined with "Watermelon" ($P<0.001$), but the recovery period was shorter ($P<0.05$).

Keywords: medial patellar luxation; surgery; osteochondral graft; trochlear dysplasia; small-breed dogs

RESUMO

O objetivo deste estudo foi apresentar um novo método cirúrgico para correção da luxação patelar medial em cães de raça pequena com displasia troquelar e hipoplasia marcada do côndilo femoral medial. A abordagem "Melancia" foi aplicada juntamente com a recessão da cunha trocolear ou recessão do bloco trocolear e consistiu em aumentar a altura do côndilo medial com um auto-enxerto osteocondral parecido com uma fatia de melancia, colocado em uma fenda adicional no côndilo femoral medial para evitar o relaxamento pós-operatório da patela. A coorte do estudo incluiu 19 cães (25 juntas) de raças pequenas (Pinscher, Pomeranian, e Chihuahua) com luxação patelar medial de segundo grau. Catorze juntas foram submetidas à cirurgia de recessão em cunha combinada com enxerto de "melancia", e 11 juntas: para bloquear a cirurgia de recessão com enxerto de "melancia". A trocleoplastia de "melancia" combinada com o enxerto de "melancia" foi clinicamente bem sucedida e com baixo percentual de pequenas complicações pós-operatórias. A duração média da anestesia foi significativamente maior para a recessão em bloco combinada com "Melancia" (P<0,001), mas o período de recuperação foi mais curto (P<0,05).

Palavras-chave: luxação patelar medial; cirurgia; enxerto osteocondral; displasia troquelar; cães de raça pequena

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INTRODUCTION

Medial patellar luxation (MPL) is a common orthopedic disease caused by complex morphological musculoskeletal abnormalities affecting the entire pelvic limb that affects predominantly dogs from small breeds (Linney *et al*., 2011; Perry and Déjardin, 2021).

The choice of operative technique depends on the nature of bone abnormalities, detected radiologically. The surgery should not be postponed because of existing risk for aggravation of tissue damage and bone deformities (Wangdee and Torwattanachai, 2010). Surgical techniques for MPL correction belong to one of two main groups: soft tissue reconstructions and bone tissue reconstructions. Often, combination of methods from these groups is required (L'Eplattenier and Montavon, 2002).

The normally shaped trochlear groove is essential for static stability of the patella whereas the trochlear dysplasia is a risk factor of instability. The four types of trochleoplasty: chondroplasty, sulcoplasty, trochlear wedge recession and trochlear block recession approach this condition to reshape the trochlea (Talcott *et al*., 2000) and restore patellar stability and normal quadriceps extensor mechanism.

This study presents a novel surgical technique for operative treatment of medial patellar luxation in small-breed dogs combining classical block recession or wedge recession surgery with an osteochondral autograft with the aim to reduce postoperative recurrence of kneecap luxation in dogs with trochlear dysplasia and marked hypoplasia of the medial femoral condyle.

CASUISTRY

The study included 19 dogs (13 dogs with unilateral MPL and 6 dogs with bilateral MPL, a total of 25 joints). The diagnosis was made after clinical examination and radiography. Fourteen joints were submitted to wedge recession surgery combined with Watermelon bone grafting, and 11 joints: to block recession surgery with Watermelon bone grafting. Owners' consent about willingness to participate in the study was obtained before the surgery.

Inclusion criteria comprised dogs not older than 2 years of age from small breeds (in this study – Pinscher, Pomeranian and Chihuahua) with second grade MPL. Also, affected stifles had obvious trochlear dysplasia and hypoplasia of the medial femoral condyle as seen on tangential (skyline) pre-operative radiographs. The sulcus angle (SA), the lateral and medial inclination angles (LTI, MTI) and trochlear groove depth were measured as already described (Garnoeva, 2021). The joints included in the study had lower median MTI values than LTI values (23° vs 27°), greater sulcus angle (135°) and shallow trochlea (1.2mm) compared to healthy subjects (Table 1).

Table 1. Pre-operative morphometric parameters of stifle joints with second-grade medial patellar luxation (median and range)

	N	Median (minimum-maximum)	Healthy joints*
LTI, ^{o}	25	27 (19-35)	28.5 (12-39)
MTI, ^{o}	25	23 (16-30)	27.5 (14-35)
SA, ^{o}	25	135 (126-148)	125 (112-153)
Trochlear depth, mm	25	1.2 (0.5-1.8)	2.05 (0.7-3.1)

* Garnoeva (2021).

Anesthesia protocol was the same for all patients: premedication with acepromazine maleate (Neurotranq®, 10mg/mL, Alfasan International, Netherlands) at a dose of 0.2mg/kg and buprenorphine (Bupaq®, 0.3mg/mL, Richter pharma, Austria; Vetergesic®, 0.3mg/mL, Ceva, UK) at a dose of 0.01mg/kg, applied intramuscularly in a syringe in the quadriceps femoris muscle. Thirty minutes apart, intravenous propofol at 5mg/kg (Propofol Fresenius®, Fresenius Kabi GmbH, Germany) was used for induction of anesthesia. Inhalational anesthesia was maintained with isoflurane (Isoflurin®, 1000mg/g, Vetpharma Animal Health, Spain) at 1.5-2.5 vol% in 100% O_2. Fluid

management included Ringer lactate infusion at a rate of 10mL/kg/h.

For surgery, patients were positioned in lateral recumbency with the affected limb exposed. With a scalpel blade No. 22, a lateral parapatellar stifle arthrotomy was performed. Shallow trochlear grooves and hypoplastic medial femoral condyles seen on radiographs were confirmed in all patients (Fig. 1). Neither erosions nor osteophytes were found out on the articular surface and femoral condyles. The patellar ligament and cruciate ligaments were intact.

Figure 1. Perioperative view demonstrating the obviously shorter medial femoral condyle.

The trochlear groove was deepened by cutting either a double V-shaped wedge at an angle of 40° with blade No. 22 (in 14 joints) or a rectangular block with bone chisels (11 joints), sparing the medial trochlear ridge as much as possible. Before returning the wedge or block into the deeper groove, an osteochondral autograft resembling a watermelon slice was collected from the lateral femoral condyle with blade No. 15 (Fig. 2). In the medial femoral condyle, a 3-4 mm slot was cut with blade No. 11 where the watermelon slice-shaped autograft was incorporated to increase the height of the medial condyle (Fig. 3).

During the final stage, the joint capsule was sutured with absorbable 2-0 polydioxanone Mayo mattress sutures (PDS, Kruuse, Denmark).

In the post-operative period, infection was prevented by oral administration of 12.5mg/kg amoxicillin/clavulanic acid (Synulox® RTU, Zoetis, Belgium) at 12-hour intervals for 7 days. The owners were instructed to restrict movement for two weeks. Information about the day when the operated limb was loaded was received by phone calls from owners, whereas information for lameness presence and grade, pain and postoperative complications was collected at the time of the control examination one month after the surgery. Control computed tomography scans were performed by the 30th post-operative day (Fidex, Animage, USA) using the following parameters: 110.0kV, 0.08mAs, 0.16mm. Three-dimensional images for evaluation of the position of the osteochondral autograft were reconstructed via ANIMAGE software (Animage, LLC, California, USA) (Fig. 4).

The clinical outcome (restoration of limb function) was evaluated as per Cook *et al*. (2010) as “full function” - the operated limb bore body weight both in rest or during movement, dogs went up and down stairs without discomfort, the patella was positioned in the center of the trochlear groove or “acceptable function”: normal gait, stable weight-bearing, willingness for walk and play, but the patella was positioned above the medial femoral condyle.

Figure 2. The osteochondral autograft resembling a slice of watermelon.

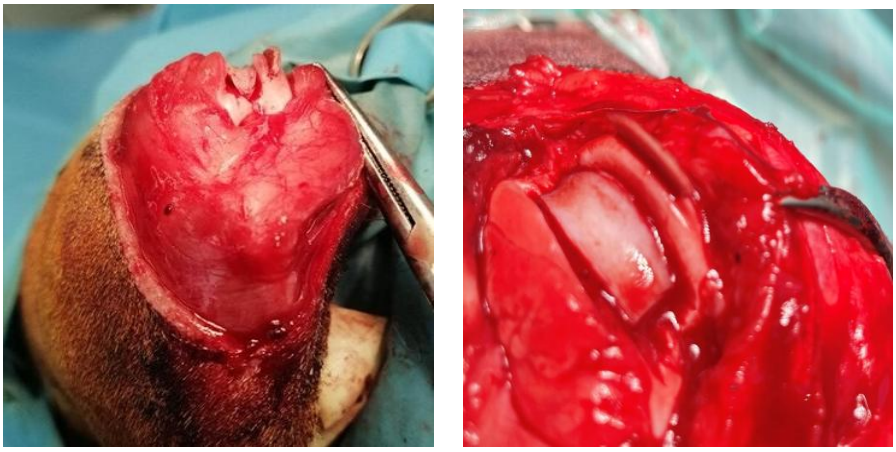

Figure 3. Views from trochlear wedge recession + Watermelon (left) and trochlear block recession + Watermelon (right).

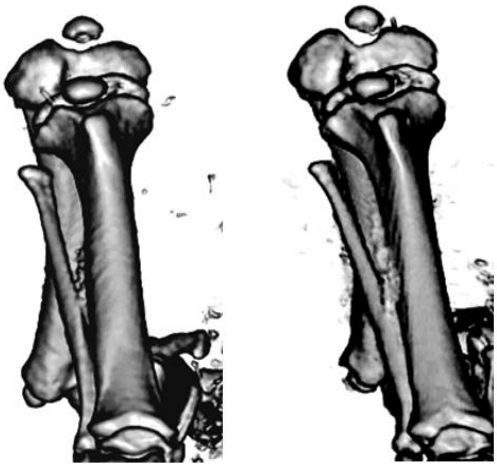

Figure 4. Left: Preoperative computed tomography scan showing the shallow trochlear groove and medial condyle hypoplasia; Right: view depicting the deepened trochlear groove and the "Watermelon" graft incorporated in the medial femoral condyle.

Differences between the two surgical techniques were assessed by the non-parametric Mann-Whitney test for continuous variables and chi-square test for categorical variables (MedCalc v.10.2.0.0, MedCalc Software, Belgium).

The summary of outcomes of performed operations is presented in Table 2. There was a statistically significant difference in median duration of anesthesia between both approaches (P<0.001). Also, dogs whose stifles were submitted to block recession + "Watermelon" grafting began to load the operated limb considerably earlier (post operative day 16) compared to median time necessary for stifles submitted to wedge recession tracheoplasty + "Watermelon" (post operative day 24; P<0.05).

None of operated stifles showed either pain or patellar reluxation one month after the surgery. By the end of the first postoperative month, first-grade lameness was found out in the six dogs with bilateral luxation, in which 6 joints were operated by wedge recession + "Watermelon" and the other 6 – to block recession + "Watermelon".

Severe postoperative complications were not observed. Two joints operated by block recession + "Watermelon" and another 2 joints operated by wedge recession + "Watermelon" exhibited minor complications (seroma formation).

The clinical outcome in operated joints with second grade MPL was evaluated as "full function" in 8 out of the 11 joints submitted to block recession + Watermelon technique (72.7%) and in 13 out of the 14 stifles submitted to wedge recession + Watermelon (92.8%). The function of the other 4 joints was assessed as "acceptable".

Table 2. Post-operative parameters in stifles with medial patellar luxation, submitted either to trochlear block recession + "Watermelon" or trochlear wedge recession + Watermelon. The values are presented either as median [minimum-maximum] or number

Parameter	Block recession + "Watermelon" (n=11)	Wedge recession + "Watermelon" (n=14)	P
Duration of anesthesia (min)	131 [120-140]	101.5 [90-114]	<0.001
Day of limb loading	16 [11–34]	24 [7–34]	<0.05
Lameness at the first postoperative month			
no	5/11	8/14	
yes	6/11	6/14	
Pain at the first postoperative month			
no	11/11	14/14	
yes	–	–	
Recurrence of luxation			
no	11/11	14/14	
yes	–	–	
Postoperative complications			
no	9/11	12/14	
yes	2/11	2/14	
Clinical outcome			
full function	8/11	13/14	
acceptable function	3/11	1/14	

DISCUSSION AND CONCLUSIONS

The necessary restraint of the kneecap within the trochlear groove is not always achieved by trochleoplasty techniques alone, as the desired groove shape and depth corresponding to patellar size and shape could not be always attained. With low trochlear condyles, the patella may reluxate under the forces exerted by the quadriceps extensor mechanism. That is why soft

tissue and bone reconstruction are often combined to achieve the desired stability of the patella within the trochlear groove (L'Eplattenier and Montavon, 2002).

Preoperative tangential radiographs of dogs revealed a shallow trochlea (SA – 135°; TD – 1.2mm) and medial femoral condyle hypoplasia (MTI – 23°). That is why our intention was to combine classical wedge recession or block recession tracheoplasty with osteochondral graft to increase the height of the medial ridge and with lateral soft tissue imbrication. Apart its role for restraint of the patella within the trochlear groove, the lateral imbrication of the joint capsule and fascia lata contributed also to stabilization of the osteochondral graft and impeded its migration.

Although various clinical outcomes from both trochleoplasty techniques were reported (Linney *et al*., 2011; Fujii *et al*., 2013; Wangdee *et al*., 2013), it is generally affirmed that they do not result in severe articular degeneration. The presented "Watermelon" technique also belongs to bone reconstruction methods because the osteochondral autograft was intended to increase medial femoral condyle's height. To the best of our knowledge, no information about the average duration of anesthesia for the different surgical techniques used for medial patellar luxation treatment is available. In this study, the anesthesia time was significantly longer in block recession + "Watermelon" as compared to wedge recession + "Watermelon" due to longer time needed for cutting the osteochondral block with chisels of various size.

Lameness is an essential clinical sign in all orthopedic diseases. In dogs with patellar luxation, post-operative lameness is attributed to degenerative alterations in both operated and non-operated joints (L'Eplattenier and Montavon, 2002). Several studies reported that regardless of the used surgical technique, 77% to 92% of dogs with MPL showed no or only mild lameness (Stanke *et al*., 2014). In this study, only the six patients with bilateral patellar luxation showed grade one lameness by the 1st post-operative month. The recovery in bilaterally affected patients is expectedly longer due to the increased load on the contralateral limb.

A correlation between the appearance of osteophytes and post-operative pain was reported (Innes *et al*., 2004). None of patients from this study showed pain one month after the surgery. An earlier study of ours reported that stifles operated by block recession trochleoplasty recovered faster with fewer signs of degenerative joint disease (Garnoeva and Paskalev, 2019). In this study, dogs operated with block recession + "Watermelon" surgery loaded the operated limb significantly earlier (on the 16th post-operative day) which was probably due to the wider trochlea, preservation of a larger part of the articular cartilage combined with increased medial ridge height.

The established minor complications (seroma in 2 joints operated by wedge recession + "Watermelon" and another 2: by block recession + "Watermelon") may be attributed to the suture material and insufficient rest during the first post-operative weeks. Reluxations were not observed.

A limitation of this study was the short post-operative monitoring period. Better evaluation of clinical outcome will be possible with longer follow-up periods and larger number of operated patients.

In conclusion, preoperative determination of trochlear depth and medial trochlear inclination angle on tangential radiographs is important for the proper choice of surgical treatment technique. The presented technique combining trochleoplasty with incorporation of an osteochondral autograft resembling a watermelon slice turned out to be suitable for canine stifles with marked trochlear dysplasia and medial condylar hypoplasia. It additionally increased the height of the medial trochlear condyle and prevented a common post-operative complication – reluxation of the patella.

The results from this study demonstrated that the combination of sulcus-deepening trochleoplasty (either block or wedge recession) and "Watermelon" grafting was clinically successful and with low percentage of minor postoperative complications. Despite that the mean duration of anesthesia was longer for block recession combined with "Watermelon" ($P<0.001$), the recovery time was significantly shorter ($P<0.05$). More extensive research on this technique will

throw light on its success in patients with higher grade of medial patellar luxation and its long-term outcomes.

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