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Triple Antiluxation Patellar Suture Surgery for Medial Patellar Luxation in Dogs - a Pilot Study with Short-Term Outcomes

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ABSTRACT

***Background*:** Patellar luxation surgery in dogs is aimed at correction of patellar misalignment in relation to the trochlear groove, stabilization of the joint and tension balance in the peripatellar soft tissues. Timely surgery especially in immature dogs, is essential to shape a trochlear groove of adequate width and depth, to modify abnormal forces on growing bones and prevent long-term joint damage. In dogs up to 2 years of age, soft tissue techniques may be attempted to mitigate the negative effects of the abnormal loading on the developing joint and the potential risk of joint disease associated with arthrotomy and trochleoplasty. Recent advancements in veterinary orthopaedics are focused on the development of less invasive surgical techniques. They not only enhance the return of patients to normal activity levels, but also offer several potential benefits, as smaller incisions, reduced anaesthesia time and blood loss compared to traditional open surgeries. The present pilot study describes a new, less invasive surgical method for treatment of low-grade medial patellar luxation (MPL) in young dogs - the triple antiluxation patellar suture (TAPS) and presents the short-term outcomes on the basis of clinical and diagnostic imaging data.

***Materials, Methods & Results*:** The TAPS surgery was applied in 19 dogs (23 joints) with grade II MPL. The technique does not involve arthrotomy: only the skin, subcutaneous tissue and fascia latae are incised while the joint capsule remained intact. After alignment of the patella in the centre of the trochlear groove, the soft tissues are fixed in 3 points with non-absorbable Mayo sutures arranged in a checkerboard pattern. The results were monitored at the end of the 2nd and 6th postoperative months using the Bologna Healing Stifle Injury Index (BHSII) and computed tomography imaging. The median (IQR) time for the TAPS method was 29 (26-30.75) min. The dogs began to bear weight on the operated leg after median (IQR) 4 (2-4) days. The evaluation of the patients' condition by the BHSII tool showed a statistically significant increased scores 2 months after surgery in all groups of parameters with exception of the joint stiffness. By the 6th post-operative month, the differences were significant ($P < 0.001$) for all studied indicators. The greatest improvement occurred in the parameters assessed visually (gait, lameness) - by 71.5% compared to the preoperative period. The limb function scores increased by 26.3% on the 2nd month and by 47.4% on the 6th month.

***Discussion*:** Apart the lower risk of postoperative infection, the short TAPS surgery time, respectively the short time under anaesthesia is especially suited for juvenile and young patients as the immaturity of their hepatic and renal systems associated with slower drug metabolism and elimination poses specific risks from prolonged effect of anaesthetics. One of the main advantages of the presented operative technique is that it is less invasive as the joint remains intact. That is probably the cause for the substantially earlier beginning of weight bearing with the operated leg - on the 4th post-operative day. Although trochleoplasty was not performed in our study, the rate of reluxation was relatively moderate. This may be due to the fact that all dogs had grade II MPL, weighed less than 5 kg; moreover, although shallower, the trochlear groove morphology was preserved. The reluxation rate is comparable to that obtained in dogs treated with arthroscopic fascia imbrication without trochleoplasty. The presented surgical technique can be suitable for correction of intermittent MPL in dogs with trochlear groove shallower than normal but with preserved trochlear morphology due to the short recovery period and the lack of some risks associated with open joint surgery (e.g. infection).

Keywords: medial patellar luxation, small-breed dogs, surgery without arthrotomy.

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INTRODUCTION

The medial patellar luxation (MPL) has a significant impact on dog's quality of life and can lead to osteoarthritis and other stifle injuries [6,33]. Patellar luxation surgery is aimed at joint stabilization and correction of patellar misalignment in relation to the trochlear groove. The choice of the most appropriate procedure takes into account the patient age, weight, luxation grade, skeletal deformity and cartilage degeneration [22]. Several open techniques are developed, e.g. trochleoplasty, tibial tuberosity transposition, and/or soft tissue reconstruction [2,34]. The key to successful management of MPL is to identify and correct the factors contributing to patellar displacement in each patient and often, a combination of techniques is necessary to provide proper stability and patellar tracking [17].

In dogs from small breeds, intermittent or grade II MPL is the most frequently seen in clinical practice [3]. The abnormalities of such dogs (e.g. trochlear dysplasia) are not always severe enough to necessitate bone reconstruction requiring more extensive dissection and arthrotomy. In them, soft tissue techniques may be attempted to correct the abnormal loading on the developing joint [14].

Recently, efforts in veterinary orthopaedics are focused on techniques that offer benefits as smaller incisions, reduced anaesthesia time, swelling and pain compared to traditional open surgeries while enhance the return of patients to normal activity [27,31]. Thus, the aim of the study was to present a new joint-sparing surgical method for treatment of grade II MPL in dogs using a triple antiluxation patellar suture (TAPS) and to evaluate short-term outcomes of its application.

MATERIALS AND METHODS

Animals

The study was performed from February 2024 to July 2025 in 19 dogs (4 Mini-Pinschers, 5 Chihuahuas, 7 Pomeranians and 3 Yorkshire Terriers; 11 males and 8 females). The dogs' age and body weight (median; IQR) was 17 months; 12-24 months and 2.3 kg; 1.8-2.9 kg, respectively. The distribution of animals in relation to their sex (P = 0.6464) and breed (P = 0.6058) was uniform. Criteria for inclusion in the study comprised: dogs from small breeds only (Mini-Pinscher, Chihuahua, Pomeranian, and Yorkshire Terrier); type of patellar luxation (only medial and spontaneous), and grade of MPL - only grade II according to Singleton [28]. Exclusion criteria were higher MPL grade, history of trauma, and orthopaedic co-morbidities. The total number of operated joints was 23. The surgery of the 2nd joint in the 4 dogs with bilateral luxation was done after the end of the follow-up period, e.g. at least 6 months apart.

Diagnostic imaging examinations

CT images were obtained in a distoproximal direction, with the dog in dorsal recumbency with extended pelvic limbs. For deep sedation, 0.2 mg/kg acepromazine maleate[1] and 0.01 mg/kg buprenorphine[2] were applied together in the quadriceps femoris muscle. After 30 min, 5 mg/kg propofol[3] was administered intravenously for induction of anaesthesia.

CT scans of the femoral trochlea were performed using a 32-slice CT scanner[4] in a helical mode. Detector slice thickness was 1 mm, tube voltage: 120 kV, tube rotation time: 0.8-1 s, pitch: 0.6-1 with tube currents adjusted according to the size of the patient. The reconstructed slice thicknesses and increments were between 1 mm and 3 mm. Continuous 3D CT data were created using a bone algorithm. DICOM-images were imported into Syngo Via View&Go software[4] for measurement of the sulcus angle [4], lateral and medial inclination angles [17] and trochlear depth [23] (Figure 1).

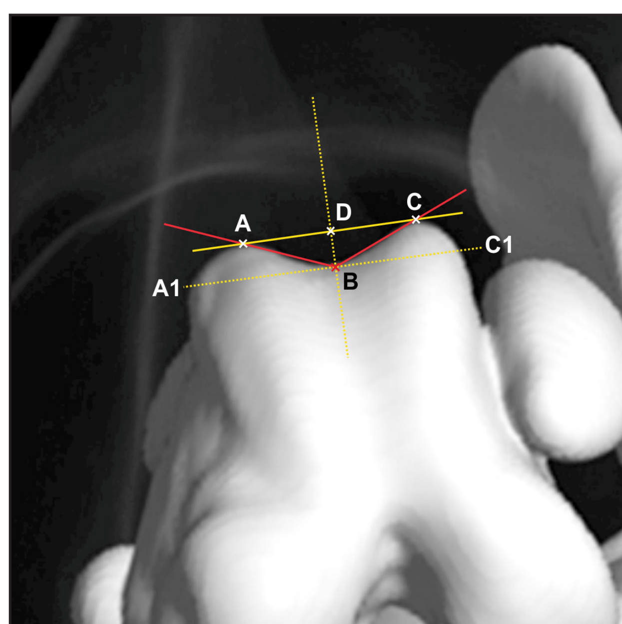

Figure 1. Trochlear morphology measurements on 3D reconstructed trochlear groove. A1C1- Line connecting the most prominent caudal points of both femoral condyles. AC- Line connecting the lateral and medial trochlear ridges. ∠ABC- Sulcus angle. DB- Trochlear depth. ∠ABA1- Lateral trochlear inclination. ∠CBC1- Medial trochlear inclination.

Anaesthesia protocol

Anaesthesia protocol was the same for all patients: premedication with 0.2 mg/kg acepromazine maleate[1] and 0.01 mg/kg buprenorphine[2], applied together in the quadriceps femoris muscle. After 30 min, 5 mg/kg intravenous propofol[3] was used for induction of ana-esthesia. Inhalational anaesthesia was maintained with isoflurane[5] at 1.5-2.5 vol% in 100% oxygen. Ringer lactate was infused at a rate of 10 mL/kg/h.

Surgery protocol

The patients were positioned in lateral recumbency, the affected limb on top. After craniolateral approach, only the skin, subcutaneous tissue and the fascia latae were incised with a scalpel blade #22; the joint capsule remaining intact (Figure 2). After palpation of the patella, it was manually manipulated in the trochlear groove centre. The antiluxation sutures pattern resembled a checkerboard: at a distance of 1-2 mm from the patella, soft tissue imbrication was performed from the lateral side in 2 points: proximally and distally, and in a single point (the centre) from the medial side. With 2 Mayo mattress sutures, the tendon of the quadriceps femoris muscle was enclosed proximally and distally to the patella from the lateral side and in the final stage, the knot was tied caudoproximally and caudodistally close to the lateral fabella (Figure 3a). A single Mayo mattress suture is placed on the medial side, that also enclosed the quadriceps muscle tendon with knot tied close to the medial fabella (Figure 3b). Thus, the 3rd medial suture played the role of a kind of a "stop" retaining the patella in the trochlear groove centre.

Antiluxation Mayo sutures were made with 2-0 non-absorbable suture material[6]. The skin and subcutaneous tissue were routinely closed with absorbable 2-0 or 3-0 polydioxanone suture material PD-X[7].

In the post-operative period, infection was prevented by oral administration of 12.5 mg/kg amoxicillin/clavulanic acid[8] at 12-h intervals for 7 days. The owners were instructed to restrict movement for at least 2 weeks.

Post-operative follow-up

Information about the duration of the surgical procedure was obtained from individual patient anaesthesia record and about the day of bearing weight with the operated limb - from the owners.

Examinations of all patients were performed before the surgery, and by the 2nd and the 6th post-operative months. They included clinical examination and computed tomography for measurement of the sulcus angle, the trochlear depth, lateral and medial inclination angles. During all control examinations, the dogs were sedated with respect to the accurate performance of the postoperative follow-up procedures.

The surgery outcome was evaluated by the Bologna Healing Stifle Injury Index (BHSII), developed by Pinna *et al*. [24]. BHSII was calculated on the basis of a 2-part questionnaire with 34 multiple choice questions. It included 10 questions from the clinical exam filled by the clinician (3 questions from visual exam of gait and 7 from the manual exam) and 24 questions filled by the owner (12 questions for assessment of pain; 7 for assessment of each of stifle stiffness and function). Each question received a numerical score from 0 (no problems) to 4 (severe problems) except for question S4 about the urinating position where the score zero corresponded to the usual position without problems and the score 4 - to unusual position. The total scores of each domain were then transformed from 0 to 4 into a scale from 0 to 100 where 0 corresponded to serious stifle problems and 100 - to absence of problems. Clinical record BHSII score (CR- BHSII) is the sum of scores from the 10 questions from the clinical exam; owner questionnaire BHSII score (OQ - BHSII) is the sum of scores from the 24 questions answered by owners. Finally, the total BHSII score was obtained as:

$$BHSII = 100 - \frac{\text{total score of all domains} \times 100}{136}$$

Statistical analysis

The normal distribution of data was verified with the Kolmogorov-Smirnov test. The numerical data are presented as median and interquartile range and the categorical variables (breed, sex) - as number and percentage. The Friedman non-parametric test was used to test the differences among the studied parameters on the different post-operative periods. Conover's test was used as *post-hoc* test in cases of positive Friedman test result (P less than 0.05). The responsiveness of BHSII, that is its ability to detect clinically important changes, was presented in terms of Cohen d effect size and calculated as the average changes in scores from month 0 to 2, month 2 to month 6 and month 0 to 6, divided by the pooled standard deviation of all measurements. A Cohen d value of 0.5 to 0.8 indicates a moderate effect, 0.8 to 1.2 - a large effect, 1.2 to 2.0 - a very large effect, and >2.0 - a huge effect [20]. The statistical software MedCalc 15.6[9] was used for computations.

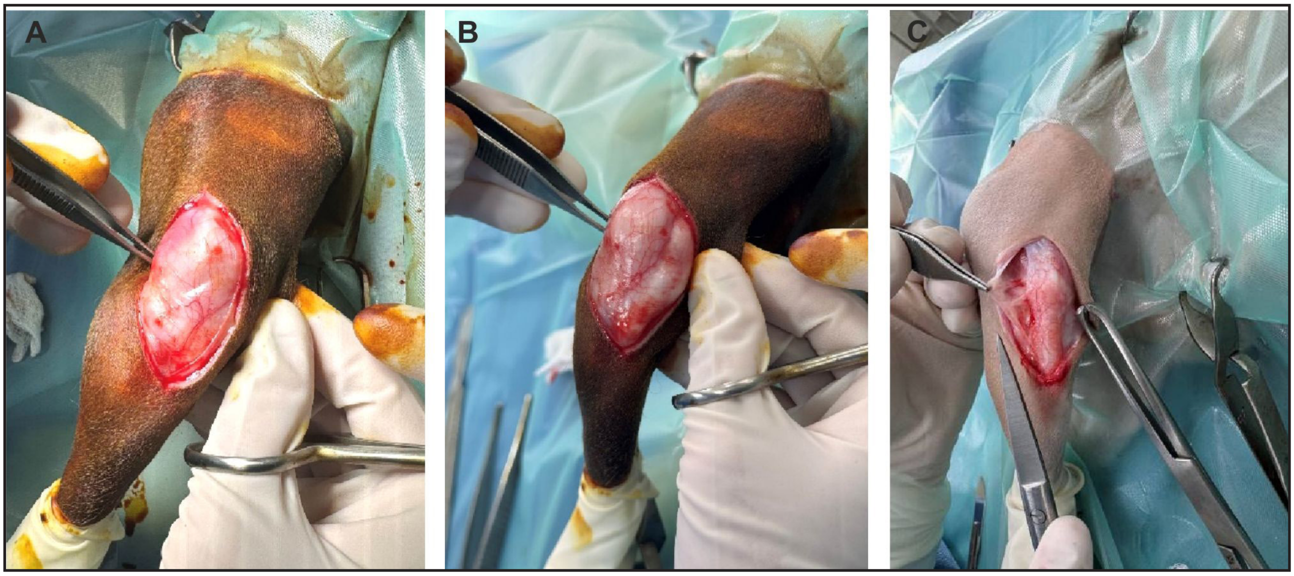

Figure 2. Craniolateral parapatellar approach to the stifle joint. The skin (a), subcutaneous tissue (b) and fascia latae are dissected (c) without opening the joint capsule.

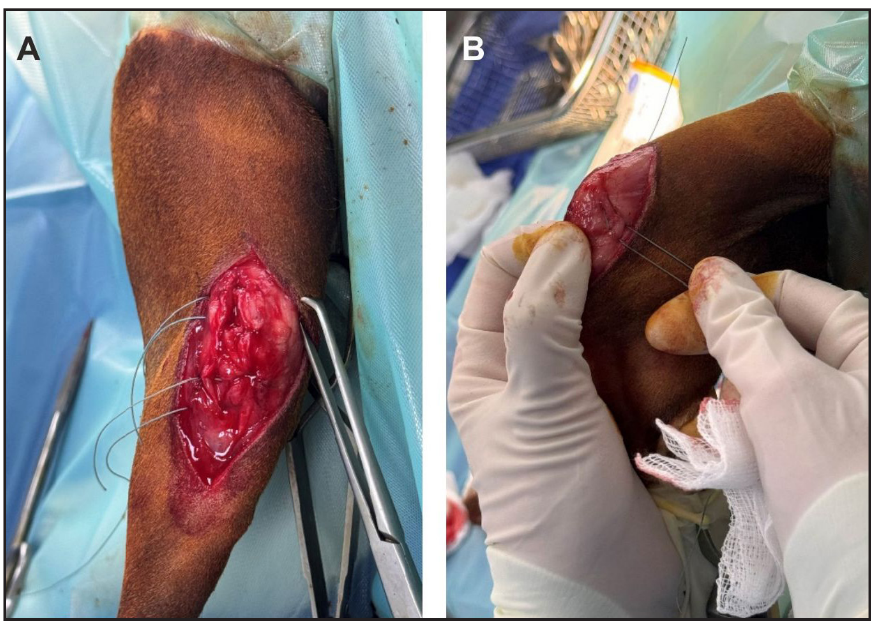

Figure 3. Placement of 2 Mayo sutures proximally and distally to the patella from the lateral side (a); placement of the 3rd Mayo suture centrally, from the medial side (b).

RESULTS

The median (IQR) time for the TAPS method was 29 (26-30.75) min. During the first post-operative days, only mild discomfort after leg palpation was reported. The dogs began to bear weight on the operated leg after median (IQR) 4 (2-4) days. Post-operative complications with loosening of the 2 lateral sutures occurred in 2 of operated stifles (8.7%) due to failure to comply with the recommendations for post-operative activity restriction - on the 8th day in a 12-month-old male Chihuahua after jumping from a height and on the 11th day in an 11-month-old male Pomeranian while playing with another dog. In the remaining 21 operated joints, the post-operative period was smooth. The 2 joints were re-operated with the traditional trochleoplastry technique. The data from the 2 joints with reluxation were not used in the analysis of joint range of motion and morphology, yet were included in the BHSII tool for more objective assessment.

The median (IQR) joint flexion angle before the surgery was 50° (46-52.25°). By the 6th post-operative month it was significantly smaller (45°; $P < 0.001$) [Figure 4a]. Similar significant changes were observed for the extension angle - by the 6th month it was significantly greater (158°; $P < 0.001$) vs 153° (148.75-156°) before the surgery [Figure 4b].

The measured parameters describing the trochlear groove morphology before and after the TAPS surgery are presented on Figure 5. There was a statistically significant increase ($P < 0.001$) in the depth of the trochlear groove 6 months after TAPS surgery (median; IQR 1.5 mm; 1.400-1.625 mm) compared to the preoperative depth (1.3 mm; 1.200-1.500 mm). The sulcus angle decreased significantly by the 6th month of follow-up (129°; 127.00-134.25°) [$P < 0.001$] compared to the preoperative values (130°; 128.75 to 136.00°) and to those by the 2nd month ($P < 0.001$) after the surgery. The medial trochlear inclination increased significantly ($P < 0.001$) 6 months after the operation, in contrast to the lateral trochlear inclination, which did not change considerably ($P = 0.330$).

The evaluation of the patients' condition by the Bologna Healing Stifle Injury Index (BHSII) tool showed a statistically significant increase in BHSII scores 2 months after surgery in all groups of parameters with exception of the joint stiffness (Table 1). By the 6th post-operative month, the differences were significant ($P < 0.001$) for all studied indicators. The greatest improvement occurred in the parameters assessed visually (gait, lameness) - by 71.5% compared to the preoperative period. Regarding the results from the owner questionnaires, the greatest improvement occurred in the function of the limb (by 26.3% on the 2nd month and by 47.4% on the 6th month), followed by pain (by 20.5% on the 6th month) and stiffness (by 14.3% on the 6th month).

The total BHSII scores for the different follow-up periods are illustrated on Figure 6. The median total score by the 6th month - 98.48 was significantly greater ($P < 0.001$) in relation to preoperative (76.52) and month 2 scores (90.15). The responsiveness of the BHSII tool in terms of Cohen d effect size was 1.45 from month 0 to month 2; 1.44 from month 2 to month 6; and 2.7 from month 0 to month 6.

Table 1. Changes in scores of individual groups of parameters included in the Bologna healing stifle injury index before and after TAPS surgery (median values and interquartile ranges; n=23).

Month of examination	Prior to TAPS surgery	Two months after TAPS surgery	Six months after TAPS surgery
Clinical record (CR) domains			
Visual examination	58.33 (41.67 - 75)	91.67 (83.33 - 100)	100 (100 - 100)
Manual examination	82.14 (75 - 91.96)	92.86 (86.61 - 96.43)	96.43 (96.43 - 100)
CR – BHSII score	75 (67.50 - 86.25)	92.50 (88.13 - 95.00)	97.50 (97.50 - 100)
Owner questionnaire (OQ) domains			
Pain	81.25 (69.27 - 87.50)	87.50 (83.85 - 91.15)	97.92 (95.83 - 100)
Stiffness	93.75 (81.25 - 100)	93.75 (89.06 - 100)	100 (100 - 100)
Function	67.86 (60.71 - 83.93)	85.71 (82.14 - 95.54)	96.43 (93.75 - 100)
OQ - BHSII score	78.26 (70.38 - 88.59)	89.13 (85.05 - 92.12)	97.83 (96.74 - 99.73)

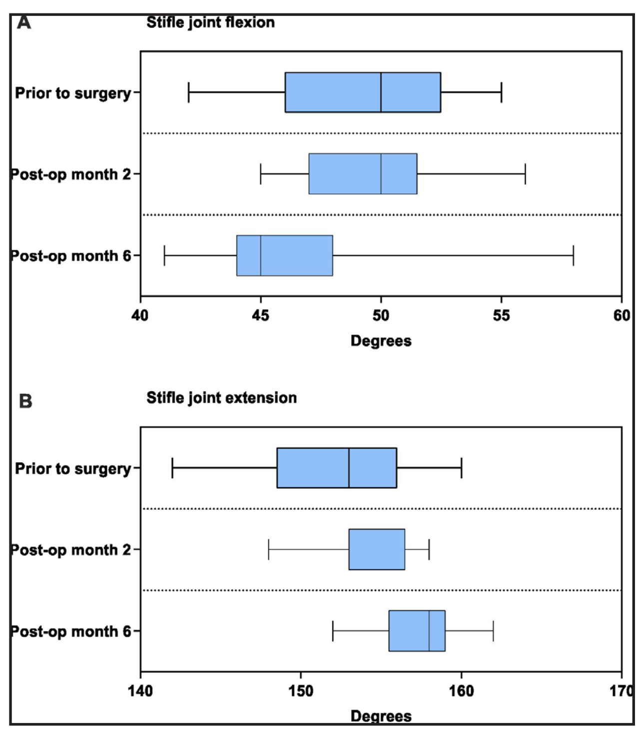

Figure 4. Stifle joint flexion (a) and extension (b) angles of dogs before and after TAPS surgery [median and interquartile range; n=21].

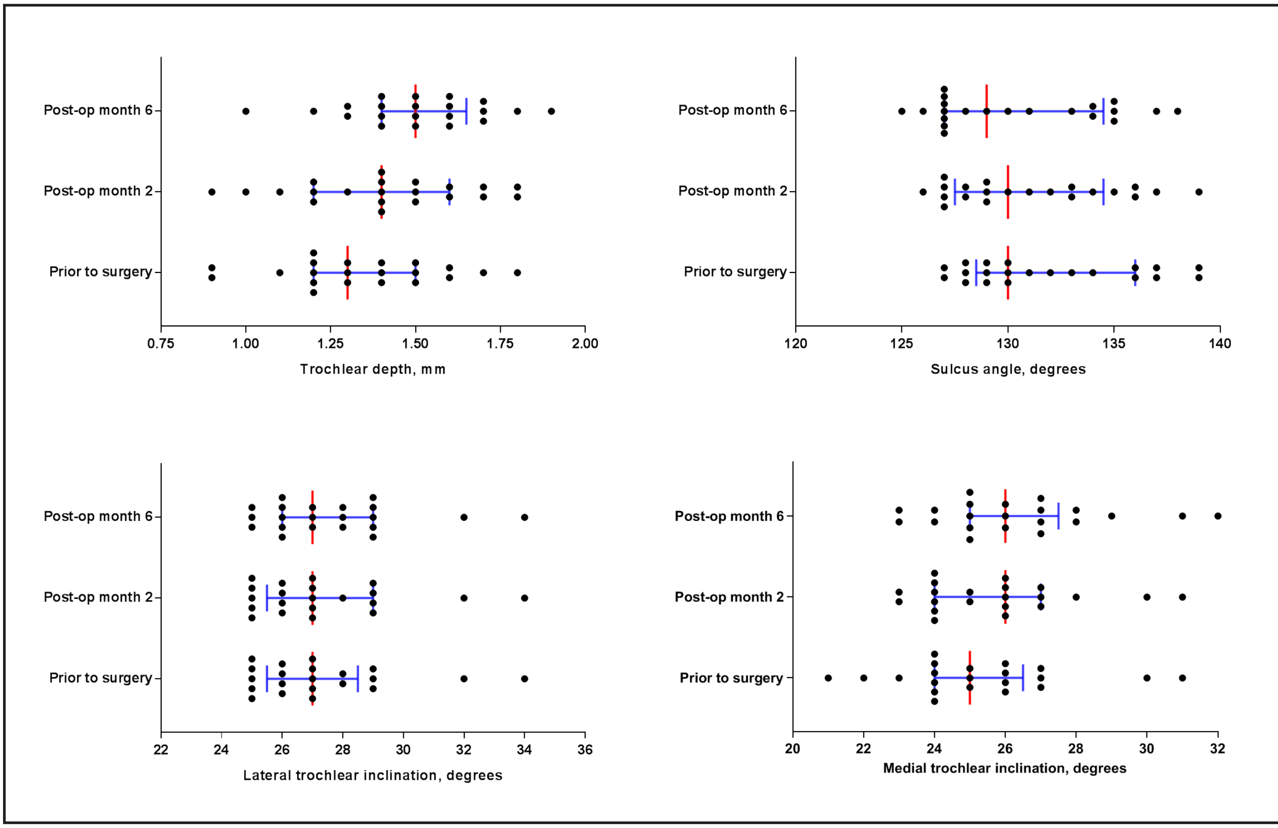

Figure 5. Scatterplots of parameters describing trochlear groove morphology of dogs before and after TAPS surgery. Red lines correspond to median value and blue lines - to the interquartile range (n=21).

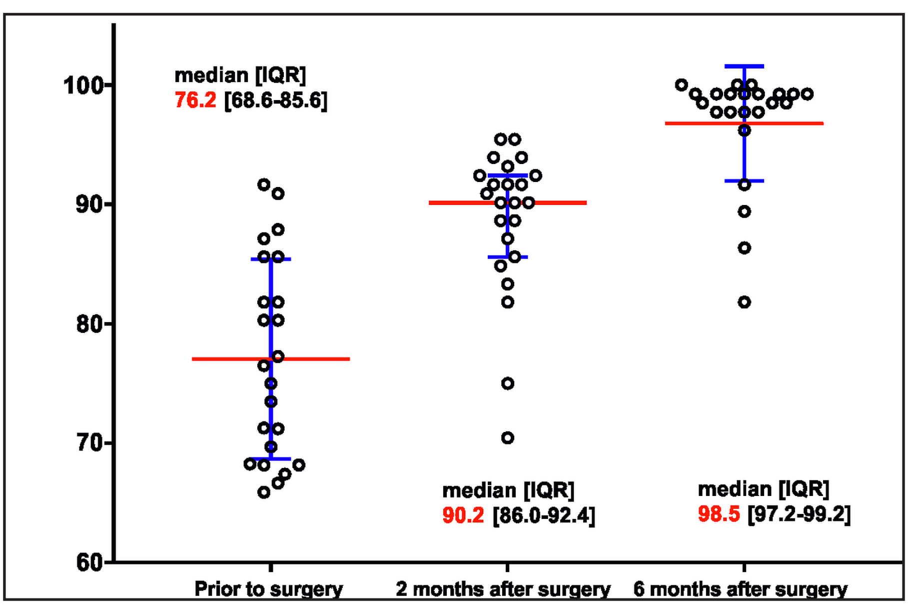

Figure 6. BHSII scatterplots in dogs before and after TAPS surgery. Red lines correspond to me¬dian value and blue lines - to the interquartile range (n=23).

DISCUSSION

Surgical techniques for MPL treatment belong to one of 2 main groups: soft tissue reconstruction methods and bone reconstruction methods [11,18]. The main objective of our study was to assess the short-term outcomes from the application of the joint-sparing TAPS technique for treatment of 2nd-grade MPL in small breed dogs, which can be attributed to soft tissue reconstructive methods.

There are only few studies reporting the MPL surgery duration in dogs. The median duration of block recession surgery was 37.0 min (range: 24-45 min) [15]. The comparison of TAPS surgery time with that of wedge and block recession in dogs from the same small breeds in previous studies of ours [12] showed that TAPS was performed for a median of 29 min which was a significantly shorter time ($P < 0.001$) than both block recession surgery (median 54 min) and wedge recession surgery (median 45 min). In another study, the median surgical time for small-to-medium-size dogs <20 kg body weight that underwent femoral trochleoplasty (trochlear wedge or block recession) with medial soft tissue release, lateral imbrication and lateral TTT was 75 min (range 25-195 min) [25]. Apart the lower risk of postoperative infection, the short TAPS surgery time, respectively the short time under anaesthesia is especially suited for juvenile and young patients as the immaturity of their hepatic and renal systems associated with slower drug metabolism and elimination poses specific risks from prolonged effect of anaesthetics [10,13].

In our opinion, one of the main advantages of the presented operative technique is that it is less invasive as the joint remains intact. That is probably the cause for the substantially earlier beginning of weight bearing with the operated leg - on the 4th post-operative day. For comparison, this median time was significantly shorter ($P < 0.001$) than median times following wedge recession surgery (on the 18th day) and block recession surgery (on the 5th day) [12].

Carrera *et al*. [7] analysed 5 cases of early surgical grade III or IV MPL treatment in juvenile dogs with closing wedge osteotomy of the distal femur (4 patients), 3 of them having also tibial tuberosity transposition. Two animals required trochleoplasty. Mean time to beginning of weight bearing was 9.8 ± 5.5 days, whereas time to bone healing was 55 ± 24 days. In another study [9] the mean recovery time after surgical correction of MPL including release of vastus medialis muscle without trochleoplasty was 5.6 ± 0.37 days (mean ± SEM). In the study of Yoon *et al*. [36], the mean recovery time was 3.4 ± 1.5 weeks (median 4 weeks) in cases where trochleoplasty was not performed and 6.1 ± 4.3 weeks (median 4 weeks) in cases treated by trochleoplasty regardless of the preoperative MPL grade.

The effect of any orthopaedic technique is maximum when it manages to correct the existing deformities responsible for the occurrence of the disease. If patellar luxation occurs early in life and the patella is not centrally located, the trochlear groove may remain shallow or even absent, further aggravating the condition [26]. The TAPS technique fixes the patella in the trochlear groove,where it exerts a constant retropatellar pressure in young patients. Possibly, in young adult dogs the trochlear articular cartilage is still elastic and therefore more susceptible to mechanical impact as seen from by the observed changes in sulcus angle values and the changes in the trochlear depth.

The MPL diagnosis and surgery early in life prevents subsequent skeletal abnormalities and erosions of the femoral trochlea. Thus, the progressive wear of the medial trochlear ridge which further increases patellar instability may be avoided [16] as demonstrated by the increase in the medial trochlear inclination 6 months following the TAPS surgery due to the deepening of the trochlear groove.

The gait analysis is one of the most objective and repeatable tests for monitoring the recovery after joint surgery. Because of expensive gait analysis equipment and the need from specific training, our study used Bologna healing stifle injury index (BHSII) as an accessible useful tool for assessment of the clinical results at the 2nd and 6th months of the recovery after TAPS surgery. The BHSII is an evidence-based tool originally developed and validated for evaluating the healing of stifle joints treated after CCL rupture surgery [24]. While most of the existing studies report short-term post surgery clinical outcomes, long-term outcomes more than 1 year post-surgery are also evaluated by follow-up examinations or interviews with the dogs' owners [5,30,35].

The rate of reported various postoperative complications after surgical treatment of patellar luxation varies from 18% to 43% [1,8,29] depending on the surgical technique used. In several studies, patellar reluxation is outlined as one of the common complication after MPL surgery with rates of 0-48% [3,21,29].

The relatively high incidence of patellar reluxation is attributed to incorrect assessment of bone deformities or inadequate choice of surgical method. The risk of reluxation is reported to be higher if trochleoplasty is not performed [1]. According to Cashmore *et al*. [8] patellar reluxation is 5 times more likely if trochleoplasty is not performed. Although trochleoplasty was not performed in our study, the rate of reluxation was relatively moderate. This may be due to the fact that all dogs had grade II MPL, weighed less than 5 kg; moreover, although shallower, the trochlear groove morphology was preserved. The reluxation rate is comparable to that (12.5%) obtained in a case series with 8 dogs treated with arthroscopic fascia imbrication without trochleoplasty [19]. Although it is agreed that age and gender have no impact on frequency of complications [1], increased age has been associated with a reduced risk of complications [29]. Decreased patient activity following surgery and improved bone quality in mature animals are considered potential contributors to this finding. In our study reluxation occurred in 2 active male dogs at the age of 11 and 12 months and the complications resulted from non-observance of recommendations in the post-operative period from the part of owners.

The major limitations of the present study consist in the lack of power analysis to determine the optimum size of the study cohort, the small number of patients and the short follow-up time. While a 6-month follow-up period is generally sufficient from a clinical point of view, this monitoring period does not allow detecting possible osteoarthritis changes, which are often reported after MPL surgery [32,33].

CONCLUSION

The described triple antiluxation patellar suture (TAPS) surgical technique for correction of medial patellar luxation in dogs from small breeds is joint-sparing as arthrotomy is not performed, so relevant degenerative changes later in life are not expected. The method can be suitable for young and adult dogs with shallow trochlear groove but preserved trochlear morphology, moderate level of physical activity due to the short recovery period and the lack of risks associated with open joint surgery (e.g. infection). Strict compliance to post-operative recommendations, in particular regarding restriction of activity, is necessary to avoid complications.

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Ethical approval. Approval for the study was received by the Trakia University Ethics Committee (protocol No. H001-2023.48 of 23 January 2024). The owners of patients from the study cohort have signed a standard informed consent form containing a clause authorising the use of signalment and/or clinical data gathered during the procedures by the hospital's academic staff for research purposes. The anonymity of owners (name, address and phone number) was respected.

Declaration of interest. The author reports no conflicts of interest and is responsible for the content and writing of the paper.

Artificial intelligence statement. The author declares that no artificial intelligence tools were used in the generation and analysis of data or in scientific content production of the manuscript. The author is solely responsible for the work.

REFERENCES

1 **Arthurs G.I. & Langley-Hobbs S.J. 2006.** Complications associated with corrective surgery for patellar luxation in 109 dogs. *Veterinary Surgery*. 35(6): 559-566. DOI: 10.1111/j.1532-950X.2006.00189.x.

2 **Ballatori C., Modenato M. & Sbrana S. 2005.** Comparison of trochlear block recession and trochlear wedge recession in four dogs with bilateral patellar luxation. *Annali della Facoltà di medicina veterinaria di Pisa*. 58: 295-303.

3 **Bosio F., Bufalari A., Peirone B., Petazzon M. & Vezzoni A. 2017.** Prevalence, treatment and outcome of patellar luxation in dogs in Italy. *Veterinary and Comparative Orthopaedics and Traumatology*. 30(5): 364-370. DOI: 10.3415/VCOT-16-05-0073.

4 **Brattstrom H. 1964.** Shape of the intercondylar groove normally and in recurrent dislocation of patella: A clinical and X-ray anatomical investigation. *Acta Orthopaedica Scandinavica*. 68 (Suppl. 68): 11-48.

5 **Browe B.E., Kowalesk M.P., Peruski A.M., Pozzi A., Dyce J., Johnson K.A. & Boudrieau R.J. 2017.** Distal femoral lateral closing wedge osteotomy as a component of comprehensive treatment of medial patellar luxation and distal femoral varus in dogs. *Veterinary and Comparative Orthopaedics and Traumatology*. 30(1): 20-27. DOI: 10.3415/VCOT-16-07-0103

6 **Candela Andrade M., Slunsky P., Klass L. & Brunnberg L. 2020.** Risk factors and long-term surgical outcome of patellar luxation and concomitant cranial cruciate ligament rupture in small breed dogs. *Veterinarni Medizina (Praha)*. 65(4): 159-167. DOI: 10.17221/155/2019-VETMED.

7 **Carrera A.L.C., Minto B.W., Curuci E.H.P., Paula C.G., Jassniker J.B. & Cunha O. 2024.** Early surgical management of medial patellar luxation in juvenile dogs. *Veterinary and Comparative Orthopaedics and Traumatology*. 37(3): 156-161. DOI: 10.1055/s-0043-1777347.

8 **Cashmore R.G., Havlicek M., Perkins N.R., James D.R., Fearnside S.M., Marchevsky A.M. & Black A.P. 2014.** Major complications and risk factors associated with surgical correction of congenital medial patellar luxation in 124 dogs. *Veterinary and Comparative Orthopaedics and Traumatology*. 27(4): 263-270. DOI: 10.3415/VCOT-13-08-0100

9 **Choi H., Kim S., Han C., Jang A., Jung H., Hwang T., Lee H.C., Hwang Y.H., Lee W.J., Lee S.L. & Lee J.H. 2018.** Surgical correction of medial patellar luxation including release of vastus medialis without trochleoplasty in small breed dogs: a retrospective review of 22 cases. *Journal of Veterinary Clinics*. 35(3): 71-76. DOI: 10.17555/jvc.2018.06.35.3.71.

10 **Cunha A.F. 2015.** Neonatal, pediatric, and geriatric concerns. In: Snyder L.B.C. & Johnson R.A. (Eds). *Canine and Feline Anesthesia and Co-existing Disease*. Ames: Wiley Blackwell, pp.310-319.

11 **Denny H.R. & Butterworth S.J. 2000.** The stifle. In: *A Guide to Canine and Feline Orthopedic Surgery*. Oxford: Blackwell Scientific, pp.517-525.

12 **Garnoeva R.S. 2019.** Comparative studies on canine patellar luxation. PhD thesis, Faculty of Veterinary Medicine, Trakia University, Stara Zagora, Bulgaria.

13 **Grubb T.L., Perez Jimenez T.E. & Pettifer G.R. 2015.** Neonatal and pediatric patients. In: Grimm K.A., Lamont L.A, Tranquilli W.J., Greene S.A. & Robertson S.A. (Eds). *Veterinary Anesthesia and Analgesia*. Ames: Wiley Blackwell, pp.983-987.

14 **Harasen G. 2006.** Patellar luxation. *Canadian Veterinary Journal*. 47(10): 817-818.

15 **Jervan M., Szlosek D.A., Friis H., Coyne M.J., DeNicola D. & Johnsen O.H. 2020.** Characterization of C-reactive protein in dogs undergoing medial patellar luxation surgery. *PLoS One*. 15(5): e0231445. DOI: 10.1371/journal.pone.0231445.

16 **Kowaleski M.P., Boudrieau R.J. & Pozzi A. 2012.** Stifle joint. In: Tobias K.M. & Johnston S.A. (Eds). *Veterinary Surgery: Small Animal*, St. Louis: Elsevier Saunders, pp.973-988.

17 **Laurin C.A., Levesque H.P., Dussault R., Labelle H. & Peides J.P. 1978.** The abnormal lateral patellofemoral angle: A diagnostic roentgenographic sign of recurrent patellar subluxation. *Journal of Bone and Joint Surgery*. 60(1): 55-60.

18 **L'Eplattenier H. & Montavon P. 2002.** Patellar luxation in dogs and cats: Management and prevention. *Compendium on Continuing Education for The Practicing Veterinarian*. 24(4): 292-298.

19 **Longo F. & Pozzi A. 2024.** Early experience with arthroscopic imbrication in dogs with patellar luxation: a case series in 8 dogs. *Veterinary and Comparative Orthopaedics and Traumatology*. 37(05): S111-S142. DOI: 10.1055/s-0044-1791295.

20 **Mckechnie D. 2025.** Determining clinically significant patient change with effect sizes: considerations for clinicians and researchers. *Australian Journal of Advanced Nursing*. 42(2): 43-53. DOI: 10.37464/2025.422.1949

21 **Perry K.L., Adams R.J., Andrews S.J., Tewson C. & Bruce M. 2017.** Impact of femoral varus on complications and outcome associated with corrective surgery for medial patellar luxation. *Veterinary and Comparative Orthopaedics and Traumatology*. 30: 288-298.

22 **Perry K.L. & Déjardin L.M. 2021.** Canine medial patellar luxation. *Journal of Small Animal Practice*. 62(5): 315-335. DOI: 10.1111/jsap.13311

23 **Pfirrmann C.W., Zanetti M., Romero J. & Hodler J. 2000.** Femoral trochlear dysplasia: MR findings. *Radiology*. 216(3): 858-864. DOI: 10.1148/radiology.216.3.r00se38858

24 **Pinna S., Lambertini C., Grassato L. & Romagnoli N. 2019.** Evidence-based veterinary medicine: a tool for evaluating the healing process after surgical treatment for cranial cruciate ligament rupture in dogs. *Frontiers in Veterinary Science*. 6: 65. DOI: 10.3389/fvets.2019.00065

25 **Rossanese M., German A.J., Comerford E., Pettitt R., Tomlinson A. & de Vicente F. 2019.** Complications following surgical correction of medial patellar luxation in small-to-medium-size dogs. *Veterinary and Comparative Orthopaedics and Traumatology*. 32(4): 332-340. DOI: 10.1055/s-0039-1683872.

26 **Roush J.K. 1993.** Canine patellar luxation. *Veterinary Clinics of North America: Small Animal Practice*. 23(4): 855-868. DOI: 10.1016/s0195-5616(93)50087-6.

27 **Schmökel H.G., Stein S., Radke H., Hurter K. & Schawalder P. 2007.** Treatment of tibial fractures with plates using minimally invasive percutaneous osteosynthesis in dogs and cats. *Journal of Small Animal Practice*. 48(3): 157-160. DOI: 10.1111/j.1748-5827.2006.00260.x.

28 **Singleton W.B. 1969.** The surgical correction of stifle deformities in the dog. *Journal of Small Animal Practice*. 10(2): 59-69. DOI: 10.1111/j.1748-5827.1969.tb04021.x

29 **Stanke N.J., Stephenson N. & Hayashi K. 2014.** Retrospective risk factor assessment for complication following tibial tuberosity transposition in 137 canine stifles with medial patellar luxation. *Canadian Veterinary Journal*. 55(4): 349-356.

30 **Swiderski J.K., Radecki S.V., Park R.D. & Palmer R.H. 2008.** Comparison of radiographic and anatomic femoral varus angle measurements in normal dogs. *Veterinary Surgery*. 37(1): 43-48. DOI: 10.1111/j.1532-950X.2007.00347.x

31 **Treuting R. 2000.** Minimally invasive orthopedic surgery: arthroscopy. *Ochsner Journal*. 2(3): 158-163.

32 **Velich N., Vidoni B., Ludewig E., Tichy A. & Schnabl-Feichter E. 2025.** Comparative radiographic analysis of trochleoplasties for patellar luxation correction: inter-observer agreement of a modified osteoarthritis scoring system. *Animals (Basel.)* 15(11): 1639. DOI: 10.3390/ani15111639.

33 **Vodnarek J., Schneider E., Bockstahler B. & Schnabl-Feichter E. 2024.** Outcome of surgical correction of medial patellar luxation in dogs weighing less than 10 kg. *The Veterinary Record*. 194(8): e3994. DOI: 10.1002/vetr.3994.

34 **Wangdee C., Theyse L.F.H., Techakumphu M., Soontornvipart K. & Hazewinkel H.A.W. 2013.** Evaluation of surgical treatment of medial patellar luxation in Pomeranian dogs. *Veterinary and Comparative Orthopaedics and Traumatology*. 26(6): 435-439. DOI: 10.3415/VCOT-12-11-0138.

35 **Willauer C.C. & Vasseur P.B. 1987.** Clinical results of surgical correction of medial luxation of the patella in dogs. *Veterinary Surgery*. 16(1): 31-36. DOI: 10.1111/j.1532-950x.1987.tb00910.x.

36 **Yoon D.Y., Kang B.J., Kim Y., Lee S.H., Rhew D., Kim W.H. & Kweon O.K. 2015.** Degenerative joint disease after medial patellar luxation repair in dogs with or without trochleoplasty. *Journal of Veterinary Clinics*. 32(1): 22-27. DOI: 10.17555/jvc.2014.02.32.1.22.