Update of Hulse´s Technique for the Surgical Correction of Cranial Cruciate Ligament Rupture and Its Long-Term Postoperative Evaluation in a Group of Canines

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Abstract

Rupture of the cranial cruciate ligament is the oldest and most prevalent cause of osteoarthrosis (OA) of the patellofemoral joint (PFJ) in canines, being 75% of all PFJ surgical pathologies. To assess the long term clinical, radiological and orthopaedic results of a modification of Hulse's technique for intracapsular surgical correction of cranial cruciate ligament rupture (CrCLR). A heterogeneous population of 12 canines who had undergone surgery for CrCLR was called for the study, of which 3 underwent surgery on both PFJs. The technique was modified by using a pre folded crochet needle and a tiny lateral arthrotomy performed just under the lateral collateral ligament. This study was done after 20 months on average from de surgery (range 8 to 36 months) and all the surgeries were performed by the same surgeon. All animals were monitored during the study period, which lasted 4 months. A blind radiological assessment of 3 observers was performed using the Bioarth scale, an orthopaedic assessment to quantify the degree of claudication and PFJ angles (goniometry) and two scales were also used for the assessment of chronic pain and animal welfare i.e., Helsinki's scale and CPBI (canine pain brief inventory). The radiographic assessment of OA yielded a mean of 9.13, with SD of 5.50 and a SE of 1.42. The average subjective assessment of OA according to the Bioarth scale was moderate. The qualitative orthopedic assessment showed that 7 patients did not present claudication, 4 patients showed grade 1 claudication and one grade 2. The CPBI and Helsinki animal welfare scales showed an excellent subjective assessment by the tutors. The Hulse technique, modified with a crochet needle, was sufficient to surgically correct the CrCLR in an heterogeneous population of 12 canines, achieving that all patients functionally used the operated limb or limbs, possessing a very good to excellent quality of life according to their owners, despite having evidenced a moderate degree of OA with an average of 9.13 on the Bioarth scale.

Keywords: Helsinki, osteoarthrosis, patellar instability, tibial plate levelling osteotomy, tibial tuberosity advancement, tigh rope

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INTRODUCTION

Cranial cruciate ligament rupture (CrCLR) in canines was first described by Carlin in 1926 (Carlin, 1926), it is the oldest and most prevalent cause of osteoarthrosis of the patellofemoral joint (PFJ) in canines, being 75% of all PFJ surgical pathologies (Kowaleski *et al*., 2017; Tonks *et al*., 2010). Several surgical techniques for its correction have been described and published, with several modifications. Other species have also been used experimentally in recent years to increase knowledge in the area (Zhalniarovich *et al*., 2018). The oldest techniques described are divided into two transcendental groups: extracapsular and intracapsular. Among the intracapsular techniques is that of Paatsama, who is considered the pioneer of surgical stabilization for CrCLR. He proposed the use of a fascia lata flap introduced into the femur by making a hole in the lateral condyle (Paatsama, 1952; Paatsama, 1988). From this point on, several intracapsular techniques have been described that use both fascia lata and patellar tendon and introduce them through the femur to provide stability to the PFJ. In the 1980s, Hulse took advantage of this knowledge and suggested the use of a fascia lata flap introduced from the femoral trochlea into the intercondylar fossa, passing over the lateral femoral sesamoid, anchoring it with suture material to the periosteal tissues of the distal and caudal aspect of the femur, but without the need of bone perforation (Butler *et al*., 1983; Hulse *et al*., 1980; Hulse *et al*., 1985). For decades, the use of intracapsular techniques was losing validity, due to multiple complications and lack of long-term joint stability, but despite this, they are being used again. For instance, Evolig® technique developed in 2009 and patented in 2012 by Labauread is at this moment refurbishing the intracapsular manner to repair CrCLR in dogs, as in humans (Sopena *et al*., 2020).

Numerous surgical techniques have been developed based on biomechanical concepts, rotation angles and intended to preserve extracapsular approaches which include tibial osteotomies, beginning with cranial tibial wedge osteotomy (CTWO) by Slocum in 1984 (Slocum, 1984, Kim *et al*., 2008): tibial plate levelling osteotomy (TPLO) (Slocum, 1993), tibial tuberosity advancement (TTA) (Montavon *et al*., 2002;), and lastly: centre of rotation of angulation (CORA) based levelling osteotomy (CBLO) and combinations of them (Coskun *et al*., 2023, Hulse *et al*., 2010; Raske *et al*., 2013; Schlag *et al*., 2020). Tight Rope (TR) another technique which does not include an osteotomy, is performed extracapsular, and is thoroughly described with minor complications (Cook *et al*., 2010). The performance of some of these techniques requires high expertise, equipment, and means high costs, but they are not exempt from complications, therefore the surgeon chooses the one that best suits his knowledge, skills and equipment since decades (Boudrieau *et al*., 2009; Leighton *et al*., 1999; Wiseman *et al*., 2004). Despite the existence of a wide variety of surgical techniques and modifications to them, osteoarthrosis (OA) secondary to cranial cruciate ligament rupture seems to be inevitable regardless of the technique performed (Pinna *et al*., 2019). There is widely consensus that cranial cruciate ligament rupture in canines will lead to some degree of OA, and this degree will be worse without surgical stabilization (Aragon, 2005).

Without detracting from the clinical analysis, the most objective measurement techniques for gait analysis include force platforms, baropodometric systems, kinematic systems, electromyography, and electro goniometry (Agostinho *et al*., 2011; Della Valle *et al*., 2021; Waxman *et al*., 2008; McLaughlin, 2001). Animals are monitored through complex and expensive systems that allows more precise gait evaluation. As those systems are not available in many countries, there are different methods that are recommended to be used together to assess the results of different orthopedic surgeries. For instance: Bioarth scale for the radiological study of the PFJ (Sánchez, 2006), chronic pain and welfare by the Helsinki chronic pain index HCPI (Hielm-Björkman *et al*., 2003 Hielm-Björkman *et al*., 2009), and the canine brief pain inventory CBPI (Brown *et al*., 2007), complemented by a meticulous clinical orthopedic examination and comparative goniometry values (Mostafa *et al*., 2010).

The objectives of this study were to share an update of Hulse's technique for intracapsular surgical correction of CrCLR in canines that had been discharged prior to the study at least 6 months after their surgeries. This cut-off point was established because it is understood that there are no differences in the results of orthopedic tests or in gait analysis platforms in the medium term (6 months after surgery) and in the long term (more than 12 months after surgery). There is consensus that after six months of surgeries the muscle masses are recovered, and animals should have a full discharge of weight on the operated limb independently of the technique used (Cook *et al*., 2010; Christopher *et al*., 2013).

MATERIALS AND METHODS

Ethical Approval

No ethical approval was performed during the study, and no intervention was performed on the patients to maintain the observational characteristics.

Study Period and Location

This study used a retrospective descriptive observational design and was performed in 2023 and 2024 in Montevideo, Uruguay.

Patients and Inclusion Criteria

All patients summoned for this clinical study including the cadaveric limb, were operated with their owners' consents, that included country laws, ethics, and agreed to use and share sensible information. Twelve (12) canines of different sex, breeds and ages were summoned for the study: being seven (7) females and five (5) males, with a range of three to ten years of age (n = 12). These patients had undergone surgery for CrCLR by the same surgeon using a modified Hulse's technique within 8 to 36 months prior to the study. A cut-off point of 6 months was established for the clinical assessment, on the understanding that, once this time has passed, the recovery of muscle mass and support of the limb undergoing CrCLR surgery is completed for different techniques, as well as the mid to long term results have no significative differences (Krotscheck *et al*., 2016). Three of these twelve patients had bilateral CrCLR surgeries at the same conditions. All patients were anaesthetised by an anaesthesia specialist, given premedication that included, Morphine (dose 0.4 mg/kg), Acepromazine (0.01 mg/kg) by intramuscular injection. The anaesthesia was induced by a dose of Propofol (1 mg/kg) endovenously and maintained with Isoflurane by endothraqueal tubes. The analgesia was maintained by injection of Fentanyl (5 µg/kg), as needed. The Hulse technique was used and modified using a pre folded crochet needle, performing a minimum lateral arthrotomy of 1.5 cm maximum, taking an average of 30 minutes in each surgery. The crochet needles chosen were made of 1.0 mm stainless steel with the following characteristics i.e., they were totally blunt and had a wider and flattened end which facilitated the perforation, and a slight distension of the muscle and fascicular tissues attached to the femur without causing damage, once Fascia Lata flap was introduced. No menisci were removed in any PFJ.

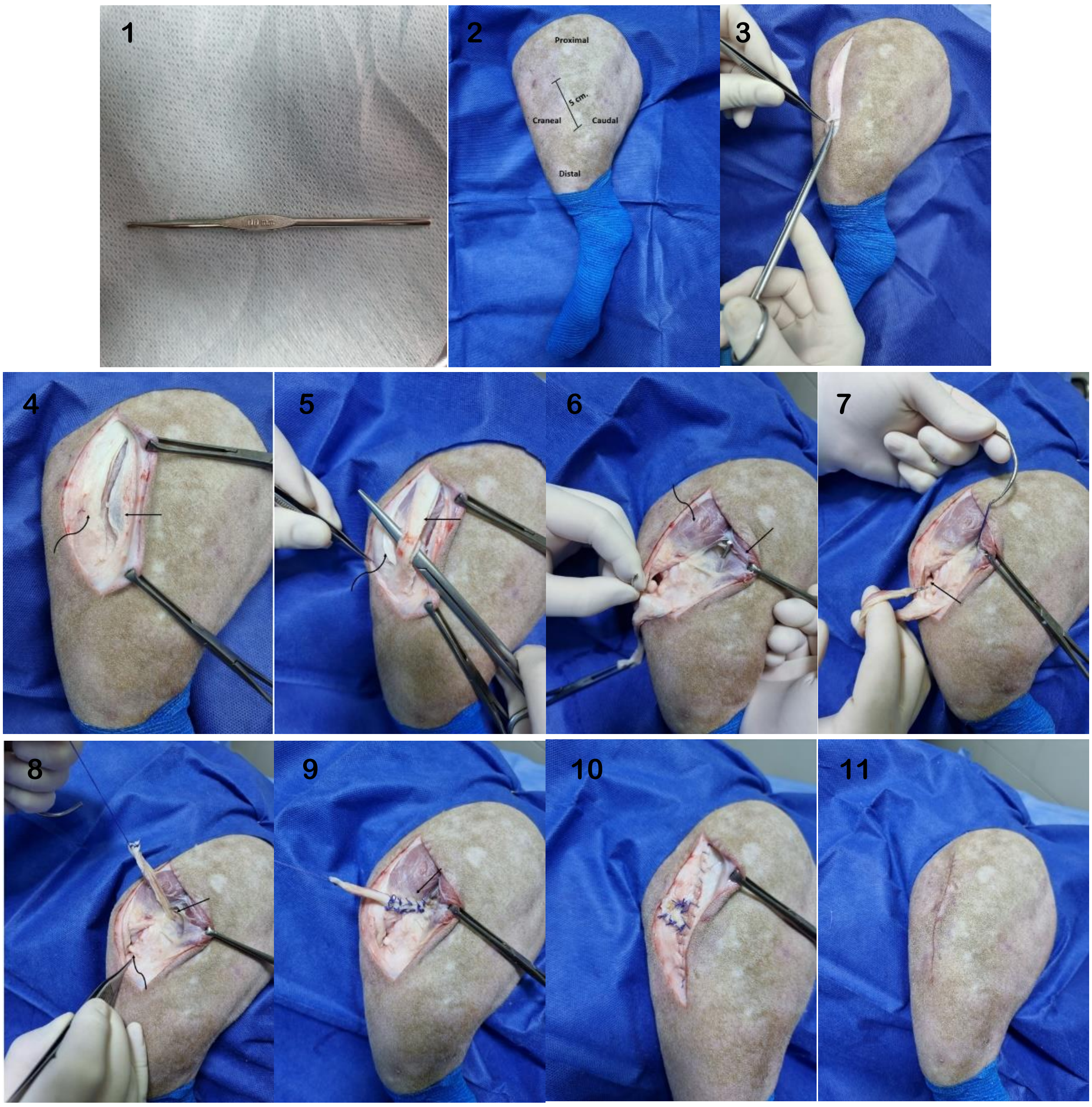
All surgeries performed ended without complications and patients were discharged after an average of 15 days, once evidence of wound healing and support of the operated limb was confirmed. All patients were referred to physical rehabilitation one week after surgery, with empirical discharge of weight at an average of 2 months postoperatively. To exemplify and obtain photographic and radiological images of the surgical technique used in these patients, synchronously with the study, the same surgery was performed on a 29 kg male canine cadaveric specimen that had been euthanized for different causes, detailing the technique step by step through photographs (Figures 1–11).

In this specimen, the cruciate ligament was artificially cut to resemble a real case of CrCLR, and x-rays were taken to show the correct route and exit of the Fascia Lata flap through the placement of the crochet needle dorsally to the lateral femoral sesamoid bone (Figures 12 and 13).

For the clinical assessment of the technique performed, all patients were clinically checked out, at the beginning of the study. Blood samples of 5 mL were taken to have health screenings of the animals that included hemogram, total proteins count, albumin, glucose, liver enzymogram and kidney function. For the hematologic profiles, it was used a blood counter, Huma Count 30 TS, and a Byosistems A15 Biochemistry analyser. The observational study was concluded in a period of 4 months, and consisted of an orthopedic evaluation, a radiological examination, and quality of life surveys carried out by their owners.

Orthopedic Exam

The orthopedic examination consisted of a static observation, a dynamic observation and an orthopedic clinical examination using specific manoeuvres to assess the PFJ together with goniometric measurements. This stage of the study was carried out by 3 veterinary observers, including the surgeon who operated on the animals in a veterinary office, on the same day that the radiological studies were performed.



Figures 1. Stainless steel crochet needle of 1.00 mm; **2.** Left pelvic limb of the cadaveric specimen where the size of the operated limb can be appreciated. Scale 5 cm; **3.** Lateral approach to the patellar patellar patellofemoral joint according to Piermattei. After the incision of skin and subcutaneous tissue, the superficial layer of the fascia lata is acutely incised; **4.** Longitudinal incision of the deep blade of the fascia lata just between the Biceps Femoris Muscle (curved arrow) and the Tensor Muscle of the fascia lata (straight arrow); **5.** Obtaining the fascia lata flap (straight arrow) just adjacent to the patella (curved arrow), the closest to the greater trochanter of the femur is incised transversely; **6.** Passage of the pre-bent crochet needle into the intercondylar fossa through a small lateral arthrotomy, under the lateral collateral ligament, entering craneo caudally and emerging dorsally to the lateral femoral sesamoid. Tensor muscle of the Fascia lata retracted caudally (straight arrow). Bisceps femoris muscle (curved arrow); **7.** Traction of the fascia lata flap sutured to the prefolded crochet needle through the intercondylar fossa (arrow); **8.** Final traction of the fascia lata flap into the intercondylar fossa (curved arrow) emerging just caudo dorsally to the lateral condyle and dorsally to the lateral sesamoid under the Tensor fascia lata muscle; **9.** Suture of the fascia lata flap to the periosteal tissues of the lateral femoral condyle and retinaculum (arrow); **10.** Suture of the articular capsule and retinaculum, fascia lata maintained in a continuous pattern, and the rest of the flap with simple stitches; and **11.** Suture of subcutaneous tissue, and skin.

Figures 12. Lateral x-ray of the cadaveric limb showing the intra-articular placement of the crochet needle.

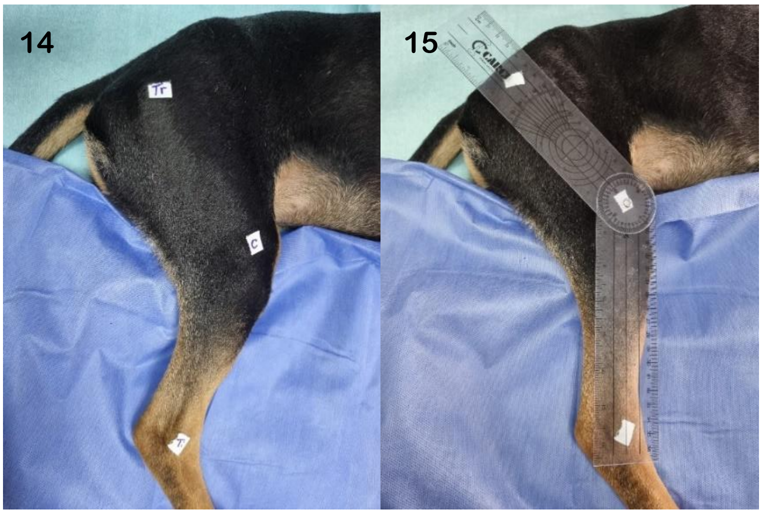
Figure 13. X-ray for cranial caudal incidence of the cadaveric limb showing the exit of the needle, emerging dorso laterally to the lateral femoral condyle just over the lateral femoral sesamoid bone.

The static and dynamic exam consisted of observation during the stay and sit position, walking, trotting and galloping gait, for which a qualitative dichotomous variable was given per observed item if present (YES/NO). Using these data, the degree of claudication was subsequently assessed, using the following 5 points Braden grading scale: (0) No claudication; (1) Intermittent claudication after rest or exercise; (2) Continuous or moderate intermittent claudication after rest and exercise; (3) Continuous moderate claudication or no weight bearing after exercise; (4) There was no support from the affected limb, the animal kept the limb in flexion (Ramírez *et al*., 2017).

Specific tests for the CrCLR were performed that included drawer test, tibial compression test (or tibial thrust), internal rotation of the tibia, presence of crepitus, and palpation of articular capsule to elicit pain (De Camp, 2016). YES/NO dichotomous variable was assessed if the tests showed these findings, and if was some evidence of pain, it was planned to run the Glasgow pain scale (Hellyer, 2016) and medicate the animal with analgesics according to the pain and the individual case.

A commercial goniometer was used for goniometric measurements of the PFJ joint with the collaboration of the same 3 observers (Sabanci, 2016). Each measurement was repeated by each observer 3 times and the average value was obtained from these 3 measurements. To standardize the measurements, 3 pieces of cloth tape (leucoplast) were pre-placed, to mark the anatomical areas and facilitate the task for each observer (greater trochanter of the femur, femoral condyle, and tibial lateral malleolus) (Figures 14 and 15).

The following measurements were obtained: the extension angle in the standing position, the maximum forced extension, and the forced flexion of the PFJ. Finally, a fourth calculated value was obtained: the range of motion (ROM) calculated by the difference between forced extension and flexion (Jandi, 2007).



Figures 14. Contact areas of the centre and central axis of the goniometer. Tr (Trochanter), C (lateral condyle of the femur), Ti (lateral malleolus of the tibia), and **15.** Correct positioning of the goniometer for measurements.

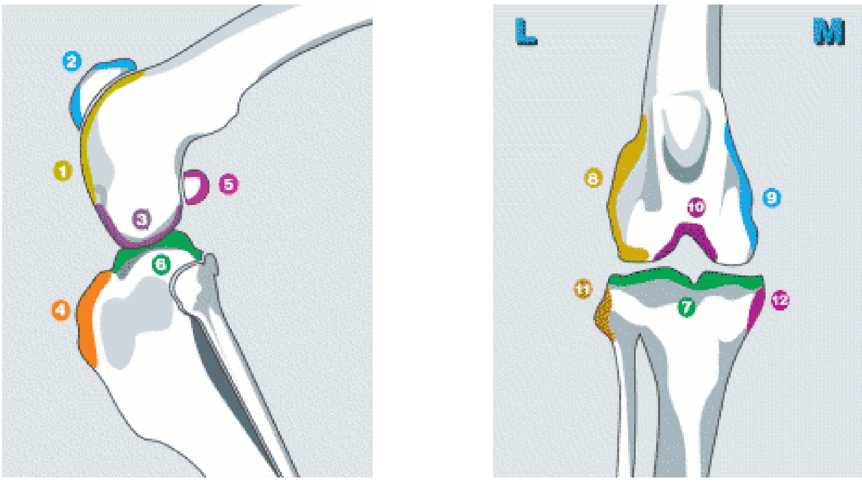


Figure 16. Points to measure on the Bioarth scale i.e., (1) Lips of the trochlea. (2) Proximal and distal poles of the patella, (3) Femoral condyles, (4) Tibial tuberosity, (5) Sesamoid bone and gastrocnemius, (6) Tibial plateau or proximal articular aspect of the tibia, (7) Tibial plateau or proximal aspect of the tibia, (8) Lateral condylar edge (Sánchez, 2006).

Radiological Study and Bioarth Scale

To evaluate the degree of radiographic OA, x-rays were performed in Lateral (L) incidences with the joint flexed at 90º and Cranial Caudal (Cr-Ca) with the joint extended. X-rays were performed under sedation using Dexmedetomidine (2 ug/kg), together with Midazolam (0.3 mg/kg) and Ketamine (0.5 mg/kg) administered intravenously. In two patients, bolus administration of Propofol (1 mg/kg) was necessary. The radiological equipment used was digital.

The images were evaluated according to the Bioarth scale by three professional observers in Veterinary Medicine with experience in radiology in a blind study, the surgeon was not included in this group of professionals. The images were sent by e-mail along with an Excel spreadsheet accompanied by the methodology to be applied, and the meaning of the scale scores. The Bioarth scale assessed 12 points of interest in the PFJ, which are detailed in (Figure 16).

The score for each point was from 0 to 3 and the correspondence was as follows: 0 (no OA), 1 (slight subchondral OA), 2 (more intense and generalized sclerosis with the presence of osteophytes) and 3 (very severe sclerosis, abundant osteophytes, presence of subchondral cysts and joint collapse). The total obtained per joint evidenced the degree of radiographic OA, according to the following detail i.e., mild from 0 to 8; moderate from 9 to 18; and severe from 19 to 36 points. A total of 540 numerical data were then received and processed from 15 joints, 12 points per joint and 3 observers.

Assessment of Chronic Pain and Animal Welfare

The quality of life and patient chronic pain were assessed through surveys using the Canine brief pain inventory (CBPI) (Annex 1) and Helsinki chronic pain index (HCPI) (Annex 2). They were fulfilled by the owners with prior guidance on the same day of the clinical and radiological examination. Each owner was given a folder with 6 copies of both scales, which had to be completed once a week for 6 weeks.

Data Analysis

The SAS on Demand software was used, and all numerical descriptive variables (Bioarth, Helsinski, Cpbi, angles), were analyzed in a normalized way using PROC MEANS programming, means, maximums and minimums, ranges, Standar error (SE) of the mean and Standard deviation (SD) were calculated. The variables of the orthopedic examination were analyzed by studying central proportions and trends. Correlations were made between Bioarth, time elapsed after surgery, age, and weight. The nominal variables breed, and name of the animals were not included in the analyses.

RESULTS AND DISCUSSION

Orthopedic Exam

Static, dynamic observation and claudication grading scale

It was observed that 100% of the patients were able to stand, sit, walk, trot and gallop supporting the operated limb(s) at the time of the study. None of the patients observed elevated the operated limb(s) during the observation. It was observed a subtle but visible lateral rotation of one limb during the trot in one of the patients.

Seven of the twelve patients had a degree of claudication of 0 in 4 at the time of the study, while in 4 patients there was evidence of a Grade 1 claudication with a subtle but visible restriction of support in trotting and galloping, but not in the walk, nor evidenced from sitting to standing position or vice versa. One patient elicited a Grade 2 claudication, showing a lack of weight relief from the operated limb during the sitting position, standing with the contralateral limb. Analgesia was recommended for this patient i.e., Carprofen 2.2 mg/kg every 12 hours for 5 days until clinical improvement was evidenced.

Clinical Examination and Specific PFJ Tests

In the clinical review, it was observed that none of the patients manifested pain with vocalization, moaning or aggressiveness to palpation maneuvers, there was no discomfort when performing the tests. In 3 of 15 joints (20%) palpable crepitus on the patellar tendon was evident during flexion. One patient demonstrated palpable patellar laxity, with no clinical evidence of luxation.

None of the patients presented positive cranial drawer test, tibial thrust, or internal rotation of the tibia, nor discomfort in performing the maneuvers, 2 patients presented discomfort on palpation of the flap suture area, which was manifested by licking of the hand of one of the observers and slight reluctance to palpation.

Goniometric Measurements

The degree of stifle extension in station obtained a mean of 127.87º, a SD of 6.95 and a SE of the mean of 2.01 (maximum of 140º, minimum of 119º). The Flexion had a mean of 46.59º, a SD of 13.40 and a SE of the mean of 3.87 (maximum 76º, minimum 30º). The forced extension had a mean of 145.37º, a SD of 9.87 and a SE of 2.85 (minimum 130º, maximum 153º). The ROM had a mean of 98.6º, a SD of 21.14 and a SE of the mean of 6.10 (maximum 129º, minimum 61º).

Radiological Study and Bioarth Scale

The overall mean (out of a total of 36 points) was 9.13 (range 2 to 17), the SD was 5.50, the SE of the mean was 1.42. The mean per observed point (total of 3 points) was 1.05 with a SE of 0.054. All the joints evaluated presented some degree of OA, with the absolute result being 8 with mild OA (range of 2 to 8 points) and 7 joints with moderate OA (range of 9 to 17).

There were coincidences between the points with the highest degree of OA and the lowest degree in the three observers, with point 9 (medial condylar border in caudal skull view) having a higher degree of OA with an average of 1.56 and point 3 (femoral condyles in lateral view) having the lowest degree with an average of 0.31. Correlations between the Bioarth scale and independent variables such as weight, age and angles were analyzed, obtaining the results expressed in Table 1.

Table 1. Data per patient according to months elapsed since surgery

Case	Sex	Age	Weight	Breed	B	OA	H	CPBI	C	ROM
10	M	7	19	Mixed	1	Mild	3	2	0	125
20*	M	6	5	Poodle	2	Mild	4	0	0	129
18	M	9	8	Poodel	4	Mild	5	3	0	116
36	M	5	12	Pug	4	Mild	7	5	0	110
10	F	6	32	Pitbull	5	Mild	10	0	1	61
16*	M	6	5	Poodle	5	Mild	4	0	0	122
18**	F	6	6	Poodle	7	Mild	11	5	1	120
11	F	6	38	Mixed	8	Mild	7	0	0	101
8***	M	3	32	Cimarron	9	Moderate	5	4	1	106
24**	F	6	6	Poodel	13	Moderate	11	5	1	108
30	F	7	36	Pitbull	14	Moderate	8	0	1	82
25***	F	6	32	Pitbull	15	Moderate	10	0	0	71
36	F	4	36	Rottweiler	16	Moderate	3	0	0	80
24	F	3	17	Mixed	16	Moderate	2	0	2	103
18	F	2	36	Cimarron	17	Moderate	0	0	1	101

Data were collected based on case (months), sex (M/F), age (years), weight (kg), Bioarth (B) (0–36 points), osteoarthritis (OA) (Mild/moderate/severe), Helsinski (H) (0–44 points), Canine pain brief inventory (CPBI) (0–100 points), Claudication (C) (0–4 points), and Range of Motion (ROM) (Grades (º)) for the 12 patients (15 joints operated). Patients who were operated on for both joints are marked with *, ** and ***.

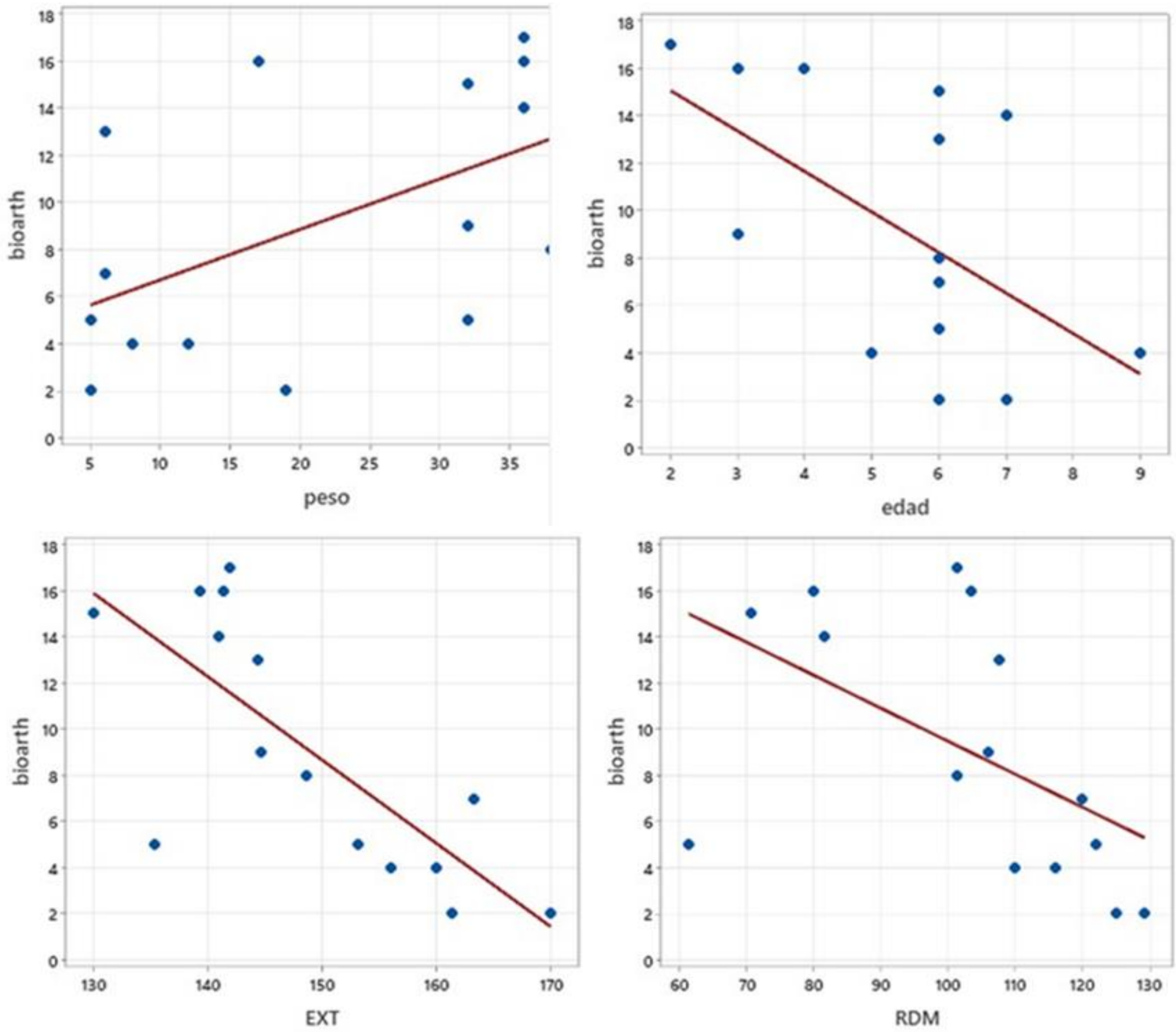


Figure 17. Bioarth correlations with weight (peso), age (edad), angle on forced extension (EXT), and range of motion (ROM), $p < 0.05$.

Assessment of Chronic Pain and Animal Welfare

Helsinski chronic pain index (HCPI)

For Helsinki the mean was 6.00 points in 44, SD of 3.46, the SE of the mean was 0.90 obtaining a percentage of 13.63 % of the maximum value.

Canine Brief Pain Inventory (CBPI)

For the CBPI an average of 1.60 points was obtained, coinciding with the value of the percentage of 1.60%, since the scale has a maximum score of 100. The SD was 2.16, the SE of the mean was 0.56. Nine of the respondents reported an excellent quality of life throughout the course of the surveys, and 3 of them had a very good perception of their dogs 'quality of life (Table 1).

From the analysis of the correlations, it emerges that there were no correlations between the radiological assessment and the different clinical assessment systems, in addition to the animal welfare scales performed by the tutors, but correlations were evidenced between the Bioarth scale and weight, age and time from surgery to imaging ($p < 0.05$). Younger dogs were associated with lower OA, heavier dogs with greater OA and older dogs with greater OA (Figure 17).

Given the impartiality and subjectivism that veterinary surgeons have in the observations of their surgical procedures, this type of evidence-based studies allows categorizing techniques or treatments in a more objective way, with the participation of other qualified observers (Aragon, 2005).

Regarding the surgical technique used, it can be stated that it was effective and efficient in the mid to long term for these patiens following the categorization proposed by Cook (Cook *et al*., 2010). Despite this, we consider that former studies should be carried out in the immediate postoperative period and in the others proposed by this author, to demonstrate that changes do not occur after six months from surgery as many other authors published. For that reason, it was established this cut off period and included patients that duplicated o indeed triplicated this time, and a variety of breeds and weights (Purnomo *et al*., 2022). There are authors who have proposed the use of the same technique with a pre-bent orthopedic wire and assessed the degree of comfort in the immediate postoperative period, but not long-term radiological osteoarthrosis, chronic pain or animal welfare (do Nascimento, 2022).

Until now there was no information about the exact position of the needle and consequently nor the course of the flap of fascia lata. The cadaveric specimen helped determined that it emerged exactly dorso lateral of lateral femoral sesamoid. (Hulse *et al*., 1980). Actually this technique is not being used in many countries because there is much progress in more complex and expensive techniques (Bergh *et al*., 2019) based on the modification of the axial axis of the PFJ such as levelling osteotomies, TTA, TPLO, rather than on the elimination of the tibial anterior thrust that is evidenced through the cranial drawer test as Hulse´s technique does, over the top and tigh rope as well.

All operated patients were studied more than 8 months after surgery and patients demonstrated a very good and excellent quality of life, as in the case of correction through over the top, TTA and TPLO (Nelson *et al*., 2012). In this study, no patient had to be re-operated, in contrast to this last reference in which patients were eliminated from the study because of catastrophic complications. In the author's opinion, this technique itself had minimal difficulty, but it is understood that there is a different learning curve for each professional and they all have different predilections when choosing the technique that best suits their knowledge and working conditions (Leighton, 1999). Regarding the duration of the technique used, it was like TR as detailed in his paper by Cook, (2010).

It was also compared surgery times using TR technique with TTA, resulting significantly longer surgical times in TTA, which increased anaesthesia expenses, anaesthetic complications and postoperative pain. The duration of each procedure using Hulse´s technique in these patients was 30 minutes on average, like that described by the mentioned author. Given the physiological and histological characteristics of the fascia lata in different species, it has been used in numerous types of free grafts, as well as for hernia resolution (Silva, 2000). The fascia lata is considered a resistant, versatile tissue, in addition to having appropriate dimensions to elevate flaps at a significant distance within the same limb. The strong distal insertion in the lateral cranial aspect of the tibial proximal area, make its use appropriate to avoid drawer movement, as well as providing intra-articular soft tissue mattress, furthermore, avoiding contact within the articular facets of the femur with the tibial plateau and rupture of the medial meniscus. Although there are more systematized and experimental validations of techniques such as over the top performed by Hulse himself (Hulse, 1985), which uses part of the patellar tendon as a flap, the same does not occur for this technique. Besides having good results, there is still lack of microscopic information about the viability of the fascia lata flap in these patients, fibrosis or other fibrils production and disposition of them such as collagen or even others that make these animals had no necessity of another surgery or surgical procedure. It is assumed that the flaps survived, and maintained their tissue properties but it could have not been demonstrated because these patients are all still alive, nulling the opportunity to investigate the limb microscopically in a postmortem operated limb (Da Silva *et al*., 2000).

Given the results, it can be inferred that, through this technique, the rupture of the medial meniscus and or its symptoms, were avoided by preventing the displacement of the tibia in relation to the femur and separating both bones as well by the flap of the fascia lata itself. It is well documented using magnetic resonance, that patients that have not been surgically managed and those with TR procedure, evidenced chronic pain due to the rupture of medial meniscus. In this study the menisci were not removed considering that the fascia lata graft avoided the collapse of it. There is increasing controversy about meniscectomies, some authors still perform those, but others have a notorious contrary opinion. Both partial and total meniscectomies have been documented as promotors of chronic pain and osteoarthrosis and many authors prefer not to intervene them despite of being damaged (McCReady, 2016[a]; McCReady, 2016[b]).

Regarding the anatomy of the PFJ some other structures collaborate in maintaining the stability of the joint and are thoroughly documented. These include both lateral and medial collateral ligaments which are also related to the parapatellar ligament that firmly attach the patella to the caudal portions of femoral condyles. In special, the lateral collateral ligament which is firmly related to the PFJ stability due to its collagen and fibres distribution. The degenerative condition of the CrCL which leads to tears and full ruptures, seems not to affect the lateral collateral ligament and it is documented to support more efficiently the mechanical forces that leads to a full rupture (Ueda, 2006). Despite this, it is also documented that multiple ligament ruptures in traumatic events can occur but are not related exclusively to the CrCLR and its degenerative origin. Other different techniques must be considered in these cases due to the traumatic origin that could lead to a severe osteoarthritis and probably with a groove replacement (Dokic, 2015). The importance of not damaging the lateral portion of the parapatellar ligament during the surgical approach is crucial to avoid major instability. For that reason, it is well recommended to make the articular approach through a mini-incision of the capsule as it is described in this update, just underneath the lateral parapatellar ligament, to avoid cutting it transversally (De Camp, 2016).

Coincidentally with some authors the use of a single method for assessing the degree of osteoarthrosis would not have been sufficient, especially considering the subjective data of the owners in this observational study (Kishi, 2016; Putame, 2019). In this, it was evident that there were no correlations between the radiological assessment and the different clinical assessment systems, in addition to the animal welfare scales performed by the owners (Allen, 2012), but correlations were evidenced between the Bioarth scale and weight, age, and the time from surgery to imaging. We agree that the clinical evaluation should prevail the radiological evaluation, and the last one, should not be considered the only indicator of the degree of comfort that the animals have or the degree of severity of a joint pathology (Christopher, 2013).

The Bioarth scale proved to be a simple and efficient tool for staging radiological osteoarthrosis in this population of canines. A moderate degree of OA was evidenced in the mean of the population studied coinciding with extracapsular techniques (Amimoto, 2019). Although this scale used is numerical and well accepted in scientific reports, observers did not use it in their daily practice, and it required prior training to standardize the perceptions observed by point. According to the author who proposed the scale, since there are twelve points to be observed, the margin of error that can be obtained at each point is diluted at the time of the final summation (Sánchez, 2006). This same author agrees that other methods, both clinical and comprehensive perception, such as pain and animal welfare scales, should be used to assess the patient globally.

With regard to the clinical assessment and visual appreciation of gait, it was observed that the perception of claudication is another important but subjective point and cannot beat the gait analysis platforms, in which the level of weight uploading in the operated limbs is efficiently and objectively meassured (DellaValle, 2015; Krotscheck, 2016; Lazar, 2005; Quinn, 2007). Although it was observed that all patients step on the operated limbs without apparent pain, it was visually evidence that one of them performed an angled gait on the longitudinal axis, so it could be inferred that in this patient the weight bearing was not complete.

The weekly assessments carried out by the tutors showed almost identical results week after week, both in the Helsinki scale and in the Cbpi, therefore, it is suggested that these scales could have been used only once, since they did not provide different data. Similarly, there are another similar scale such as the Bologna scale, and visual assessment scale (VAS), also used by owners to assess quality of life and which some authors have used to assess three different techniques: Paatsama, TTA and Tight Rope, with no objective results as well (Hielm-Björkman *et al*., 2011; Pinna *et al*., 2020). These authors analysed these surgical techniques from the first to the sixth postoperative month, showing stable or similar data during the last weeks, similarly to this Hulse´s modified technique.

With respect to the angles measured, the comparison of the mean in extension is 10º lower than healthy animals as published, while the mean of flexion is 4º higher (Jaegger *et al*., 2002). In this study, less extension and flexion in the joints with moderate osteoarthrosis was observed, the same happened with the ROM, with great variability among the patients observed, depending on the breed, weight and muscle mass of the affected limb that was opposed to the maneuvers performed by the observers.

CONCLUSION

The modified Hulse technique with a crochet needle was sufficient to surgically repair the CrCLR in a heterogeneous population of 12 canines, which upload weight in the operated limb or limbs and have very good to excellent quality of life according to their owners despite having evidenced a degree of moderate OA with a mean of 9.13 on the Bioarth scale.

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AUTHORS' CONTRIBUTIONS

CdA: performed the surgeries, made th in the study, analysis and redaction of the manuscript. AP: took and analysed x-rays and gave an objective oppinion of the results obtained in the Bioarth scale.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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