

The cruciate question: what are the right questions to ask when evaluating clinical outcomes from cruciate ligament surgery in the dog?

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Abstract

Objective: To meet the challenge of producing a clinical outcome measure, with wide application and acceptance in both clinical practice and academia for evaluating cruciate surgery in the dog.

Background: Cruciate surgery in the dog has gone through a number of changes over the years since 1952 when Paatsama published his original MSc thesis in Finland describing the use of bone tunnels and a fascia graft for replacing the ruptured cranial cruciate ligament.

Summary

The questions vets and clients ask are often different, but they all matter.

Introduction

The published peer reviewed evidence that explores comparison between the old skin graft technique and more modern osteotomy techniques is non-existent. There was never any real study of the old techniques and their advantages and disadvantages before the proposed change to osteotomy techniques first by Barclay Slocum in 1994 was accepted, and there still is none in spite of wide acceptance of these new and much more radical techniques [1] compared the TPLO to the lateral suture technique [2]. Did some radiographic comparisons of outcomes between TPLO and lateral suture. However, in human surgery replacement graft techniques have been and still are used all around the world, and a large amount of research has been done into this including evaluation of outcomes and the development of national knee registries [3-6] (Table 1) (Figure 1).

The goal of advancement in surgery should be to improve the outcomes, so the development of a description of what a successful outcome looks like is critically important.

Table 1. Cruciate surgery in the dog has gone through a number of changes over the years since 1952 when Paatsama published his original MSc thesis in Finland describing the use of bone tunnels and a fascia graft for replacing the ruptured cranial cruciate ligament.

Date	Research	Evidence based reason
1952 Paatsama (41) 1963 Vaughan (54,55)	MSc thesis Helsinki. JSAP article presenting clinical case series	Original research. Tissue transplant. Modified choice of natural graft material with clinical case evidence
1970 1984 Barr and Denny	Lateral suture OTT (over the top)	DeAngelis & Lau Looking at simplifying the technique
1994 Barclay Slocum	Theoretical. Metal implant.	Originally theory was presented in a non-peer reviewed journal with no clinical case evidence

Evidentiary value

In veterinary surgery as compared to veterinary medicine, it is far more difficult to obtain large sample sizes for studies of surgical interventions compared to pharmaceutical interventions for example.

This study is limited by the number of responses to the survey in the Veterinary Times who were interested to complete the questionnaires. The Veterinary Times circulation was 20,000 readers, but only 250 responses were received. However, this may have been a reflection of the degree of interest in the subject matter, as well as the accepted low response rate to any questionnaire where 10% is considered excellent and good enough for Governments to make major decisions.

The clinical studies carried out by the author in his own practice had the advantage of long follow up times and the quite large number (100) of cases compared to the majority of papers published in the veterinary literature.

Whilst a much bigger number of cases and a bigger survey might be carried out in the future, it is hoped that this paper will provide the basis for further exploration of these important issues in the future, and improve the data gathering within the veterinary profession. The Scandinavian countries in particular, have developed National Joint Registries for their human knee patients which have a very high compliance rate above 80% for completing questionnaires by both surgeons and patients, and this is an aspiration of the author for the veterinary profession.

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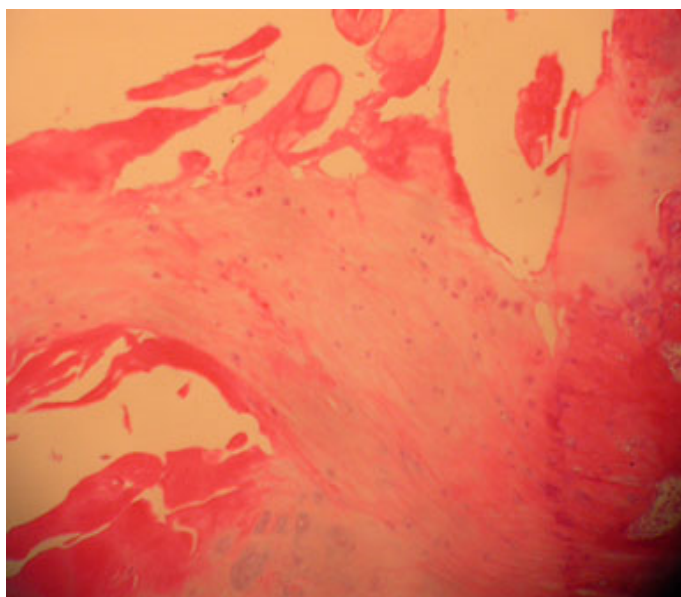


Figure 1. Picture of the graft in dog 8 years after it was inserted. (Ligamentisation).

Methods

Literature searches

30 years of clinical experience of dealing with canine cruciate surgery: reflective practice. Clinical observation and analysis of more than 100 cases in a 15-year study [7]. Client feedback in the development of 'frequently asked questions' by clients over more than 20 years [8]. Survey of veterinary surgeon and veterinary nurse opinion of their view of the most important questions to ask circulated in a questionnaire with supporting articles in the *Veterinary Times*.

Results

Data has been collected using the above different methods.

Conclusion

Acceptability of a clinical outcome measure is likely to be based on the degree to which veterinary surgeons are willing to accept a challenge to their professional practice, and the academics' acceptance of the need to include the dog owners in the evaluation. 'We need to capture and share our legacy of raw data from surgery.'

This question is a valuable one to ask:

'Are there any things you have observed that your dog cannot do now he/she has recovered from the operation that he/she could do before the injury?'

Dog owner client feedback, observation and testimonial are vital keys on which the author's motivation works as a surgeon practitioner. Patient orientated evidence that matters (POEM's) should be important for vets now and in the future.

An airline pilot has to consider the evidence that helps to prevent a disaster happening when both the lives of his passengers and his/her own life will be at stake from a failure to implement routines and procedures. A human surgeon has a human life at stake. A veterinary surgeon has his/her own reputation and that of the practice, plus the wellbeing of the patient and the real concerns of the client to take seriously.

The capture of data in this study has been done over three decades. The study shows that owner observation and feedback is an important part of the development and refining of a surgical technique which has resulted in a 96% success rate with very low complication rate. The findings have importance for future clinical decision making in cruciate surgery in the dog, and may have some value in developing an animal model for the equivalent surgery in humans.

Application

Practitioners and dog owning clients can share this data for the benefit of the dogs suffering from ruptured cruciate ligaments. Use in my own practice for my own clients and clients referred to me by other veterinary surgeons or clients who self-refer.

The concept of clinicians jointly evaluating the clinical outcomes of their services is something that has always been precious to me in my vocation, and I do not believe that I am alone in thinking this is important [9]. It would be unthinkable for clients or patients to think that their clinicians disregarded this.

In human medicine and surgery there is a long-held belief and practice that change needs to be evidence based, and carefully managed for the betterment of the service provided to patients. Radical changes may be beneficial but need to be justified with evidence. This has become institutionalised in the form of NICE (National Institute for Clinical Excellence) [10,11].

In veterinary surgery, there is very rarely any published evidence demonstrating a surgeon's complication rates to the public using those services, and if it is published in peer reviewed journals there is rarely any useful data to compare with other techniques.

'No one technique for cruciate surgery is proven to be any better than any other' continues to be stated in many standard textbooks in the absence of any data to prove otherwise. A recent textbook [12] devotes 10 pages to intra-articular grafts in dogs and concludes that it is curious why this is widely used in human surgery but not so much in dogs. There are no references to actual clinical data from this technique.

Examples of research already done in the veterinary profession include attempts to validate questionnaires for pain relief [2,13-15,16-19], and research to explore perceptions of what veterinary surgeons and clients feel are important in evaluation of clinical outcomes [15,20-23].

Our medical colleagues have long used the IKDC [24,25] score to evaluate their clinical outcomes in cruciate surgery.

The force plate has held the position of gold standard for the belief in its objectivity [26].

Acceptability is likely to be based on the degree to which veterinary surgeons are willing to accept a challenge to their professional practice, as well as the academics' acceptance of the need to include the dog owners in the evaluation.

I believe the right question to ask is 'how can the veterinary profession better recognise the good work already done in qualitative analysis and be better trained in it?' [27-30]. The big question is 'how shall we share our raw data from surgery?'

Literature searches

There is no comparison in the peer reviewed published literature between osteotomy techniques and the old skin graft technique for cruciate surgery.

There are some clinical outcome measures in the published literature, but none are widely used in practice except the simple lameness scores of 'not lame, slightly lame, moderately lame, severely lame.'

Clinical cases by the author/surgeon [7].

Lameness scoring (Ballagas, 2004). Table of outcomes from a case series of 100 dogs followed during a 15year study period (1988-2003) (Table 2).

Breed codes:

R=Rottweiler

W&C=West Highland White Terriers and Cairns.

SS= Springer Spaniel

B=Boxer

BC= Border Collie

BMD=Bernese Mountain Dog

GD=Great Dane

YT=Yorkshire Terrier

X=Cross breed

L=Labrador

CS=Cocker Spaniel

MP=Miniature Poodle

SBT=Staffordshire Bull Terrier

GSD=German Shepherd Dog

BF=Bichon Freis

TT=Tibetan Terrier

JRT=Jack Russell Terrier

BM=Bull Mastiff

GS=German Spitz

BD=Bulldog

CKCS=Cavalier King Charles Spaniel

R=Retriever

BS=Belgian Shepherd

*Became bilateral at end of the study.

One English Setter was removed from the study due to concurrent osteoarthritis of the hip. This case does not appear in the table (Table 3).

58% of cases were followed for more than 2 years post operatively (Table 4).

Table 2. Lameness scoring (Ballagas, 2004).

Lameness score	Interpretation
0	Absent.
1	Minor gait abnormality with constant weight bearing
2	Obvious gait abnormality with constant weight bearing.
3	Intermittent non-weight bearing.
4	Non-weight bearing.

Client feedback

FAQ's on the www.astonlee.co.uk website. [7,8,31-33]

In 2010, this was a summary of the 10 most commonly asked questions by clients at Astonlee Veterinary Hospital:

Many clients who were considering the choices available to them for the remedy of their dog's lameness due to a ruptured cruciate ligament studied the questions posted on the practice website in detail. Asking these clients if they had all of their questions answered or in particular 'is there any one question that was not answered for you?' confirmed and added a few to the list of FAQ's collected together and published on www.astonlee.co.uk 25.11.16 (Table 5 and 6).

What are the treatment choices for my dog?

Why do you choose your skin graft technique?

What are the costs of each choice of procedure?

What is the potential for things to go wrong?

I have heard the meniscal cartilage can be a problem with some techniques?

I have heard a clunking noise when my dog walks lame. What is this?

If the operation does fail, what can be done about it?

Making the diagnosis: as you cannot see the ligament on an x ray, why are x rays taken?

Failure rates in humans and dogs with various types of cruciate surgery.

How quickly after the dog has suffered the cruciate ligament rupture should the surgery be done?

Will my dog have to be in a plaster cast, cage rested, and any other constraints during the recovery after the operation?

I have heard that grafts are not favoured by many vets in larger dogs because of a fear of failure of the graft, and that is why many vets recommend the TPLO or other bone sawing techniques?

Questionnaire published in the Veterinary Times (references to articles and questionnaire) [20,21].

The survey found answers to a detailed questionnaire about the opinions of veterinary surgeon and veterinary nurse readers asked the question 'what are the most important questions in evaluating outcomes from cruciate surgery in the dog?' This table is a summary of the questions that were considered to be the most important (Table 7).

There were other questions considered to be of less importance and these were also reported.

Discussion

Synthesis. Why? What? How? Has the paper answered your questions about the evaluation of clinical outcomes following cruciate ligament surgery?

Which stakeholders (patients, surgeons, clinics, professions) should have access to the raw data? Research embargoes do exist for various personal and commercial reasons, so is the care of the patient subservient to 3rd party interests in the practice based research? What evidence would you consider to be pivotal to your thinking on this subject?

Table 3. Breed and sex distribution. (Median = where n=2r+1, median = the (r+1)th observation. If n is an even number 2s, median= ½ way between the sth and (s+1)th observations. If s and (s+1) are the same number, that is the median. Mean= sample mean = Ex/n.)

Breed	Nos	RH	LH	Median Time to Recover to 0 lameness (Mean in Brackets)	Nos failed	Min time in months	Max Time In months	Male	Female	Inc bilateral	Median Follow Up time (Mean In Brackets)	Range Of Follow Up times
R	9	5	4	6(6)		4	6	2	7	1	2yrs (2.1y)	0.75-3yrs
W&C	4	3	1	3(3)		3	3	1	3	0	3yr (2.25y)	0.25-3yrs
SS	3	1	2	3(1.7)		1	3	2	1	0	1yr (1yr)	1-1yr
B	8	3	5	3(3.6)		1	6	5	3	2	3yr (3.9y)	2-7yrs
BC	3	1	2	2(2)		1	3	1	2	1	3yrs (2.7y)	2-3yrs
BMD	1	0	1	3(3)		3	3	0	1	0	5yrs (5yr)	5yrs
GD	1*											
Breed	Nos	RH	LH	Median Time to Recover to 0 lameness (Mean in Brackets)	Nos failed	Min time in months	Max Time In months	Male	Female	Inc bilateral	Median Follow Up time (Mean In Brackets)	Range Of Follow Up times
YT	4	1	3	2(1.7)	1	1	3	1	3	0	0.5y (0.56y)	2month -1yr
x	28	13	15	2(2.5)		1	3	14	14	4	3y (2.79y)	1month -7yrs
L	7	4	3	2(2.4)	1	1	3	5	2	2	6yrs (3.79y)	2months -8yrs
CS	2	2	0	2(2)	1	1	3	1	1	0	3.5y (3.5y)	3-4yrs
MP	1	0	1	failed	1	lame	lame	1	0	0	2y(2y)	2yrs
SBT	3	1	2	3(3)		3	3	3	0	1	2y (2.33y)	1-3yr
GSD	4	3	1	3(2.1)		0.5	3	1	3	0	4y(3.3y)	1.5-5y
Breed	Nos	RH	LH	Median Time to Recover to 0 lameness (Mean in Brackets)	Nos failed	Min time in months	Max Time In months	Male	Female	Inc bilateral	Median Follow Up time (Mean In Brackets)	Range Of Follow Up times
BF	3	3	0	3(3)		3	3	0	3	0	0.5y (1.25y)	2month -3yrs
TT	2	1	1	2.5(2.5)		2	3	2	0	1	0.6y(0.6y)	2months -1yr
JRT	6	4	2	3(2.8)		2	3	1	5	0	2y(2.35y)	1month -6yr
BM	2	2	0	2.5(2.5)		2	3	0	2	0	1y(1yr)	2yrs
GS	1	0	1	1(1)		1	1	0	1	0	3y(3y)	3yrs
BD	1	1	0	3(3)		3	3	1	0	0	8y(8yr)	8yrs
CKCS	2	1	1	3(3)		3	3	2	0	1	1y(1y)	1yr
R	4	2	2	3(3)		3	3	1	3	1	8y(6yr)	2-10yrs
BS	1	1	0	3(3)		3	3	1	0	0	3y(3y)	3yrs
Total	100	53	47	3(2.93)	4	0.5	6	45	55	14	3yrs (2.84y)	1month -10yrs

Table 4. Age distribution at time of operation. Median; Mean.

Age at time of op	Nos of dogs	Median time to recover to 0 lameness in months. (Mean in brackets)	4 cases did not recover to zero lameness	Median Bodyweight in kgs (Mean in brackets)	Median follow up time in years. (Mean in brackets).	Range of follow up time	Confidence interval
<1year	3	3 (2.2)		20 (17.3)	3 (2.75)	0.25-5yrs	
1-5yrs	29	3 (2.2)	1 (severely obese) +1=2cases	35 (32.9)	3 (2.74)	0.1-10 years	
5-10yrs	41	3 (2.3)	1	19 (23.8)	2.5 (3.02)	0.1-8yrs	
10-12 yrs	20	3 (2.1)		15 (17.2)	3 (2.72)	0.2-7years	
12-14yrs	7	2.5 (2.6)	1	16.5 (14.3)	1.75 (2.0)	0.5-3 years	
All dogs	100	3 (2.93)	4	20 (24.26)	3 (2.84)	0.1-10yrs	
Total	100						

Table 5. Concerns of dog Owners

Concern of dog owners	Astonlee solution	Evidence base
Pain needing to be understood and treated	First 24hrs after the op in hospital for pain relief and TLC, thereafter routine pain relief at home.	Case follow up with surgeon and client observation over 30 years. Simple analgesic protocol at Astonlee.
Unable to enjoy exercise with the leg problem, but wanting to walk, run and play again	Restore joint stability and function with a new graft replacement Dogs encouraged to walk immediately after the op on a lead, no need for cage rest.	Post-operative experiences shared between surgeon and dog owners (see vets section for full report). 96% success rate at Astonlee. (See vets section for full report).
Stiffness with arthritis Rehabilitation services	Some is inevitable with any technique because of natural ageing, but we find after graft surgery, if arthritis happens, this is manageable with medication and rehab services where needed	Long term benefits of restoring limb function and stability have been observed (see vets section for results of long term follow up).
Surgical invasiveness: wanting to solve the problem but refer to the first principle of surgery which is 'First do no harm'.	Replacing the torn ligament is a lot less invasive than bone sawing techniques, and more effective and with wider application to different breeds and bodyweights of dog than lateral suture technique	There are few or no people (surgeons, academics, dog owners) who would argue against the statement 'techniques that aim to replace the ligament are less invasive than sawing the bones.'
Infection control for the surgical procedure	RCVS Hospital Standard at Astonlee, rigorous protocols in place.	Very few post op infection problems in 30 years in many types of surgery at Astonlee
Understandable explanation	Replacing the torn ligament with a new one	Technical challenges such as choice of graft, thickness of graft, location of drill to position the new graft, clinical outcomes from graft replacement, have been explored over 30 years working with the technique. Transplantation medicine is a modern science.
Track record	>30 years in cruciate surgery	Paatsama (1952), Vaughan (1966), Manning (1979-2016....)
Experience of surgeon	>35 years	

Table 6. Complications

Complications	Small risk of infection, failure of graft through tearing or failure of anchorage.	30 years' experience
Complication rates	< 0.5%	30 years' experience
Longevity	Follow ups have been >10 years	30 years' experience
Would not want to subject their dog to an operation they would not want for themselves		This is very commonly stated by dog owners coming to Astonlee

Table 7. HRQL (Health Related Quality of Life) instrument

Very important question with a high weighting in the evaluation of the clinical outcome
Success and complication rates of different surgical techniques?
Explore the client evaluation of the outcome
Ability of the dog to walk and bear weight on the leg before surgery and after the recovery?
Share the practice procedures for infection control with the client.

Table 8. The table below illustrates some of the critically important aspects, but there are many more that have been demonstrated in this paper.

Risks and hypotheses	Clinical effectiveness	Cost effectiveness
Complications	Improvement?	Best evidence
Needing same op on opposite leg	Clinical performance. Arthritis.	Solution already available (?)
Hypothesis: change technique. Peer review vs raw data.	Profit of GP, specialist practice? Reduce cost to clients by 50%	C \$1.5billion pa to \$0.75 billion pa in USA?

In this paper, the questions involved in the hypothesis ‘There is a logical analysis of data that can be collected and used to improve surgical outcomes from cruciate ligament surgery to achieve a high level of success’ have been seriously considered.

The table 8 below illustrates some of the critically important aspects, but there are many more that have been demonstrated in this paper:

Evidence showing TPLO vs skin graft =0.

Graft complication rate dog and man 2% fail, 0.5% infection. (Manning and NHS).

There are several different types of evidence that have been explored to answer the complex and multifaceted components to the question:

Types of evidence. Stakeholders.

Qualitative survey

IKDC includes surgeon and patient reports

Client/patient opinions/feedback

Surgeons’ opinions and developmental work

Anatomy, physiology and surgical technique

Picture of the graft in dog 8 years after it was inserted. (Ligamentisation) (Figure 1).

Quantitative and the debate about ‘best practice in research’.

The classical pyramid of the hierarchy of evidence is an aspiration rather than a reality for most of veterinary medicine and surgery because it is rare that studies ever achieve what this hierarchy refers to as the highest standard of evidence.

Variation within what is being measured is more widely appreciated in medicine than veterinary; eg: IKDC.

Limitations of force plate also include cost, availability.

‘What type of scientist-practitioner are you?’ (Lane and Corrie [34]. This is good question because it opens up the inner debate which is personal to each individual practitioner addressing how they actually do ‘clinical reasoning.’

Empiricism and falsification.

‘There is no such thing as objectivity, and all ‘truth’ is really someone’s version based on their background and paradigms.’ This leads to theories of social constructivism.

Qualitative analysis explores the richness of data. Quantitative analysis explores specific aspects and applies numbers to them, but in surgery there are a lot of variables.

Table 9. Pressures on delivering the original research.

Pressure	Reasons	Potential solutions
Time	Many pressures on time in a typical veterinary practice	Challenges to allocating time to a research project when many other priorities can take precedence
Cost	Time is a cost	
Research planning	Priorities and planning can be limited by interest, questions and processes being different for the practitioner compared to the academic, skill levels and support networks can be limiting	
Relevance to the practice	Very important to look at what really matters to the practitioner who is in the front line of patient care	It is no good answering a question because it is easy when the real question the practitioner is faced with requires a different and more complex approach
Data collection	Computer records, written records, interviews and consultations with clients	Systematic case recording, standardised reporting and use of computers for archiving are valuable research tools.
Resources	The practitioner researcher has to make a living from satisfying the animal owning public, so time and money for research is a precious resource. There is very little sponsorship for in practice research so it has to be chosen wisely by the clinician researcher as being of value to their work.	Time can be saved by studying the research plan before undertaking it, but with the development of surgical technique often comes the clinical decision making over time as lessons are learned which can change the course of the research and the questions being asked and answered. The rigour of making the choice of what to research without any resources other than self-funding is also an advantage in that this serves to really focus the mind on what is important and practically useful.
Ethics	Avoidance of experimentation and even double-blind trials when best practice is being questioned	Difficult for the practitioner to choose to test two different treatments when one is strongly believed by the vet and the client to be the best one
Client confidentiality	This needs to be addressed, but is not much of a difficulty except in following cases where they need to be identified.	Clinical cases can be given numbers or other references to anonymise them.
Bias	There can be bias from having only one surgeon being involved in the clinical evaluation, but the advantage of one surgeon applying the same technique is also an advantage which avoids variation between different surgeons.	Surgery involves many different variables simultaneously. Care is needed to keep the observations as objective as possible.
Sharing of data	Limitations of available repositories for data submission, archiving and comparisons in the veterinary world. Personal results may be closely guarded both for the reason of wanting to protect the surgeon from being criticised, but also if the technique is highly successful from the point of view that other surgeons may choose to practice it and take work and money away from the originator. Why would the practitioner surgeon want to do a simpler technique which earns less money than a more complicated procedure?	Knee registries in the human field have been widely used and developed. A cruciate surgery registry could be launched in the veterinary field. Sharing of data and expertise can develop referral business within the originator's practice, and it can have a wider benefit to the whole profession and the patients and clients we serve. If the simpler technique has a higher success rate with fewer and less challenging complications, it can be more satisfying and less worrying for both the surgeon and the client, and patient care. Less complications with a less complicated technique offering consistent results is less time consuming both during the surgical operation and in the period of aftercare and any remedial work needed to correct complications.
Using a novel technique or old technique that is currently not favoured by the 'majority view' of peers.	Experience using a technique is one of the important points why a client chooses a surgeon and their technique. Introducing a new and novel technique for which there are no previous clinical experiences on which to draw is a brave step.	Experience in an old technique that was previously fashionable can provide opportunities for senior surgeons to utilise their skills.
Challenge from academics and 'specialists'.	There is pressure to conform to 'expert opinion'.	Developing an evidence base and a track record is the answer. Developing an evidence base that is widely accepted as believable is a better solution.

Prankel *et al.* [16] 'These (biomechanical) techniques will not be able to replace careful clinical observation but can be a useful aide to decision making and can detect changes previously inaccessible to the veterinarian.'

Technical issues involved in developing and refining the surgical technique., and comparisons with the technique in human surgery.

Drilling the bone tunnels accurately so they are located at the origin and insertion of the cranial cruciate ligament for the insertion of the replacement graft. In human surgery, the technique is to drill from one entrance point for the drill in the tibia, and this has resulted in the femoral tunnel being located too far cranially in some cases which has been found to be a cause of some complications or failures. In the technique used in the dog, the author surgeon uses two separate entrance locations for the drill bit, starting on the distal lateral femur to

arrive at the origin of the cranial cruciate ligament, and then entering via the open stifle joint into the location of the insertion of the ligament through to the medial aspect of the tibia.

The choice of size of hole varies between different dogs and breeds because there are several variables to consider. The size of dog is important because the holes need to be appropriate so they are not too large so as to weaken the bone in a small dog, and not too small in a large dog so the thickness of the graft required is not too restricted.

The thickness of the graft varies with a larger size being used in the larger dogs. The actual thickness of the skin is smaller in smaller dogs.

The anchorage of the graft is achieved by matching the thickness of the graft fairly closely to the bone tunnels so that the bone can lock around the graft, and PDS sutures holding the graft to the muscle and connective tissue. In human surgery, dissolvable screws are used to

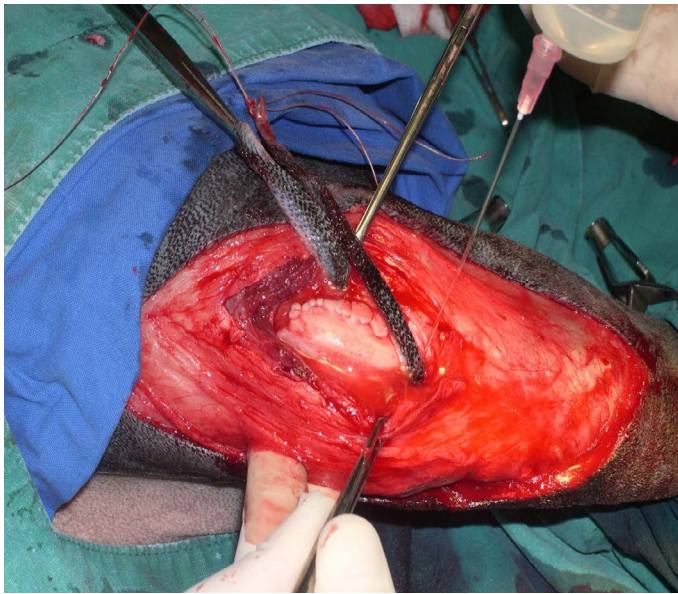


Figure 2. The questions vets and clients ask are often different, but they all matter

lock the graft into the femoral tunnel from the articular side, and there is a large amount of literature reporting technical points on anchorage.

Ligamentisation is recognised in human surgery and widely reported [35], whereas in veterinary surgery there is very little published on the subject together with a large amount of scepticism that is actually can take place. The photograph of the histological picture of a Labrador aged 15 at euthanasia after the skin graft had been placed at age 8 years provides at least some evidence that it can take place. (See above photograph). An important observation on this photograph is that the graft has nuclei in its structure which indicates this is not original collagen and the tissue was viable. It also illustrates that there is no fur growth and no infection which are two often cited reasons why modern day veterinary surgeons question the use of this skin graft technique.

Complications with graft surgery in cruciate ligament replacement in dogs

Infection

Rarely seen. Can be seen in gross swelling of the stifle joint with some heat, and some fluid swelling gravitating below the stifle down to the hock.

Preventive measures

Minimal with good surgical scrubbing technique and theatre hygiene plus good surgical technique and tissue handling.

Graft failure

Rare to see a sudden change from typically good to excellent progress when the owner typically finds the dog is running off the lead or out of control or trips and there is a sudden onset of lameness in the post op 3-month period. Cranial drawer may represent, but this is sometimes occurring with a simultaneous onset of a click which may be palpable and/or audible. Sometimes this resolves in time over the following 1-2 months, my theory being a meniscal cartilage was dislodged post op but settled down again without tearing the graft. Rarely the graft may tear resulting in a recurrence of the lameness.

Preventive measures ensure the thickness of the skin graft is 'big' for the size of dog and fits snugly in the 2 drilled bone tunnels to maximise strength of fixing once the sutures have dissolved and the bone tunnels have filled in with new bone. In some cases, the skin is of 'poor quality' in being thin and appearing to lack physical strength, or has become badly soiled by playing in manure on a horse yard, or has some red spots and/or cysts present which can be a concern for the surgeon. Consideration of hygiene of the dog at home before coming for surgery might help by asking owners to keep their dogs away from manure and to wash their dogs once or twice in the week before the operation. Consideration of prevention of post op infections might include the assessment of the skin in the week before the operation, and prescribe antibiotics and antibacterial shampoos before the operation is carried out.

Further research different breeds of dog and different types of dog within the same breed have different skin histology with differences in thickness, strength, and variations depending on hormone status/presence of Cushing's disease for example. I have successfully operated on a stabilised Cushing's dog with no complications. Further study into the type of skin structures would be helpful but has proved difficult to fund and find wider interest in due to lack of interest in the whole veterinary profession in this surgical procedure. A limited size investigation with the help of Dermatologist David Shearer found little could be distinguished on histology, but the use of an electron microscope might help to discover differences in properties of skin between different dogs and breeds.

Human surgeons use dissolvable screws for fixation of the graft which might be a useful addition to the surgical protocol if any could be made suitable and accessible within the stifle joint of the dog.

Swellings

These can be:

- 1) Cysts in the skin graft which are usually of no consequence and occur in the pieces of graft external to the stifle joint but under the skin. Rarely these are removed and sometimes contain sebaceous material which may be brown in colour. These were also recognised and reported by Vaughan (1966).
- 2) Cysts in the bone of the distal femur have been seen in 2 West Highland Terriers. Both have not resulted in recurrence of lameness, and neither resulted in any recurrence of cranial drawer. They were left alone without any noticeable problems except the owner noticed a swelling.
- 3) Fluid swelling in and around the stifle plus gravitating down the leg can be due to infection, or can be due to inflammation with no infection which resolves in time.
- 4) Fluid/pitting oedema not in the stifle but developing in the Achilles tendon area down to and below the hock. This can be associated with a worsening of the lameness but is usually of no consequence and resolves with application of frozen peas and judicious use of NSAID's.
- 5) Tumours in the bone of the distal femur have been seen in Rottweilers, one being present at the same time the owner actually heard an audible sound when the cranial cruciate ligament snapped. Occasionally bone tumours occur in the distal femur of the Rottweiler so radiographs are particularly important in this breed. There may be no connection between the development of bone tumours and the surgical technique.

Preventive measures

Hygiene to prevent infection is important, but most swellings seen are not due to infection. Some swelling can be avoided by attention to ligation of arterioles, and some dogs have very inflamed joints which have large amounts of vascularisation which can lead to post op swelling. Usually the swelling occurs in the first 2-3 weeks of the recovery period, but occasionally swelling even pitting oedema of the Achilles area can occur 1 month after the operation when the preceding 4 weeks showed no presence of swelling at all. Strict adherence to the instruction 'lead exercise only and no stairs of jumping' is critically important and not always easy to achieve owner or patient compliance.

Check lists

Airline pilots have been helping surgeons to appreciate the importance of checklists. The airline industry realised some years ago that checklists save lives and so they have rigorous systems in place to try to prevent a disaster such as the apparent running out of fuel in the recent Brazilian air crash (November 2016). They cannot prevent everything from happening but they focus on it, and surgeons have done the same now to minimise 'non-events' which they refer to as 'events which should never happen but sometimes do'. The development of checklists can help in the development of surgical technique because each check needs to have a reason behind it, and that requires reflective practice; i.e. something is learned from each critical incident or 'stroke of the scalpel.'

Further research: Is there a possible relationship between the presence of a graft in the distal femur and the development of a bone tumour?

Challenges to asking the right questions. (for vets and clients)

The question for me as a veterinary surgeon with a lifetime commitment to my profession is 'what is best for my patients?' Dog owning clients have the same question. There are technical questions as well as questions about the recovery from surgery and the ability of the patient to resume the activities enjoyed before the intervention. It is clear from history, study of the literature, personal experience of attending conferences for the past 35 years, and my own clinical experience that veterinary surgeons have been led by fashion rather than evidence. The late Professor Vaughan confirmed to me in writing before he died that he had been perfectly happy with using the old graft technique and the only reason he changed was fashion.

Clients often follow their veterinary surgeons' advice and assume it is given with a reliable evidence base. However, many clients have been challenging their veterinary surgeons to deliver the evidence that informs their decision to recommend a particular type of cruciate surgery for their dog. When that has not been forthcoming or they find it unconvincing they may choose to self-refer themselves to a place where their questions have been answered to their satisfaction. Many clients are very discerning and justifiably demanding of their veterinary surgeons in helping to make their decision for their dog who they care about very much, but they also feel they have a moral obligation to consider this carefully. Clients want to feel they have done the right thing for their dog, so they want to know what the right questions are to ask.

Many vets decide to align themselves with what is considered to be 'best practice' by the majority and what they feel is going to support them in the literature. With the removal of the old graft techniques from regular practice, there are many veterinary surgeons who feel

uncomfortable about recommending or supporting or doing the old graft techniques themselves, even though many (over 50 years old) have actually practised this in the past with success (Table 9).

Special place of practitioner research

Practitioners can have a career lifetime of continuous experience and working knowledge of clinical cases following patients for the whole of their lifetime in a special relationship with their clients. The author/practitioner/surgeon has been in the same practice he founded in 1986 continuously to the time of writing (2016).

Practitioners most value papers by practitioners [36].

'Effective communication between doctor and patient is a central clinical function that cannot be delegated [37].

Svarstad [12] There was a change in thinking from 'Follow Doctor's orders' to 'Maybe it's the Doctors who have got the problem of patients not following instructions?'

Repeatability of surgeons' results. NNT. (Number needed to treat before encountering a problem is a recent more popular method of looking at outcomes).

Each primary care consultation is an exceptional opportunity [30].

'Meetings between experts'. Sharing medical information [38].

Consultation skills are important in veterinary practice [27].

Reflection is an essential consultation skill [39].

A dog lover shares exacting standards when judging their dog's ability to exercise.

Managing clinical work.

Evaluation of technique in experienced and less experienced surgeons is important in the management of the clinical function of the practice, whether that be a general practice, veterinary hospital or a referral establishment. In human surgery, there is a realisation that complications cost a lot of time and money, as well as causing sometimes horrifying consequences for the patient. All of the considerations of different types of evidence are important in the delivery of care through surgery.

Methods and materials

Literature searches

Clinical studies by the author at Astonlee Veterinary Hospital, surgery and case follow ups over 30 years.

Over 30 years of asking clients 'what questions do you have that you would like me to answer in helping you to make your decision about the choice of intervention available to you for your dog with the ruptured cruciate ligament?'

FAQ's by clients (see www.astonlee.co.uk).

Survey in The Veterinary Times using a series of articles introducing the topic. This included a questionnaire to obtain the opinions of the veterinary surgeon, veterinary nurse and some other readers of the widely distributed publication.

Competing interests

The only competing interests which the author perceives as being in conflict with this paper are the numbers of veterinary surgeons who

have their own vested interests in making their particular choices of cruciate surgery for their patients which are rarely the technique the author uses. On the other hand, many dog owners choose the technique the author advocates and practices.

The author owns and runs his own Veterinary Hospital.

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