EXTRACORPOREAL SHOCKWAVE THERAPY (ESWT)

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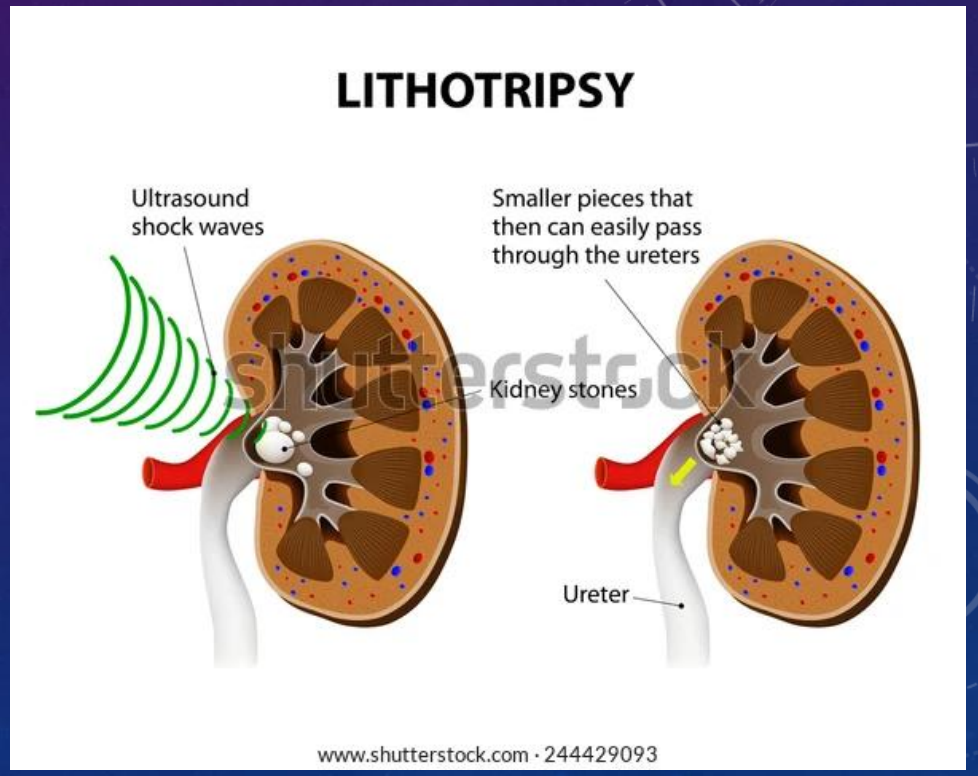
Introduction

- Extracorporeal shock wave therapy (ESWT), also known as high-energy focused sound wave therapy, was first used as a non-invasive method for the fragmentation of kidney stones in the early 1980s.
- Extracorporeal shockwaves have also been used to the fragmentation of sialoliths, choledocholiths, and pancreatoliths.
- It’s bone healing effect was discovered on pelvis during the animal lithotripsy studies.



- In equine musculoskeletal disorders includes insertion desmopathies, bone spavin, tendon and ligamentous calcification, navicular disease, exostoses, fractures and microfractures, back pain, and osteoarthritis (OA) of tarsometatarsal and distal intertarsal joints.
- In dogs as a part of the treatment regimen for hypertrophic nonunions, tendonitis, spondylosis, and OA.

http://gentek.com.tr/wp-content/uploads/2020/09/masterpuls_ultra_vet_001.jpg

- Extracorporeal shockwaves are acoustic waves of high pressure and velocity produced outside of the body.
- These waves are characterized by high-amplitude acoustic pressures (20-100 megapascals [MPa]) with a short build-up time of approximately 5-10 nanoseconds.
- These pressure waves differ from ultrasound waves because they have lower frequency, minimal tissue absorption, and are lack of a thermal effect.
- Shock waves produce approximately 1000 times the pressure magnitude of ultrasound waves and deliver energy at a controlled focal volume.

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- Mechanical energy transferred to tissues following ESWT causes various biological responses at the cellular level.
- Compression and tension generation occurs as the shockwave travels through the tissue.
- Varying amounts of reflection and transmission of energy occur at varying interfaces.
- Cavitation bubbles are made during the tensile phase of the shockwave, and as size increases, a large amount of energy is delivered to the bubble.

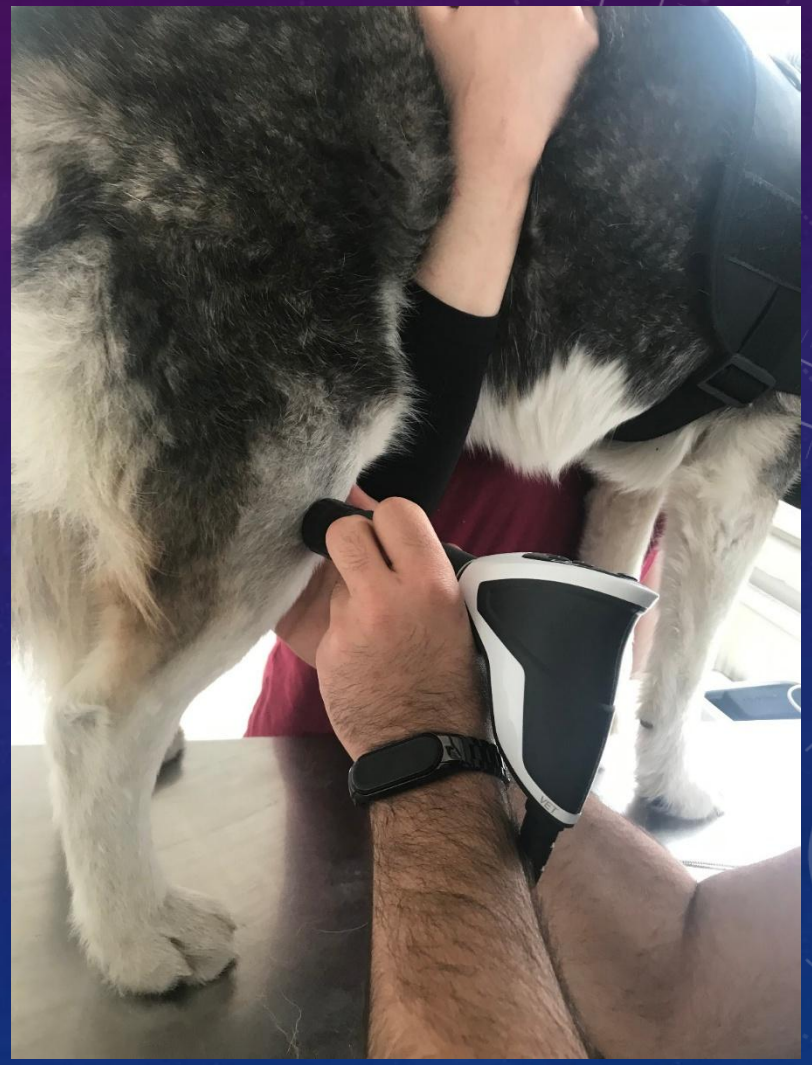
- Cavitation bubbles formed secondary to shockwave-generated compression and tension forces have the potential for deposition of large amounts of energy after subsequent collapse, releasing high-energy water jets and high-temperature production
- Cavitation also leads to the production and release of free radicals, ultimately creating chemical reactions within the tissue.
- ESWT may also increase cell membrane permeability.

https://eswt.net/wp-content/uploads/2011/06/Shockwave-Therapy-pict-002.jpg

- The exact mechanism of action of ESWT has yet to be fully elucidated; however, the mechanical stimulation of cells is hypothesized to result in increased expression of cytokines and growth factors leading to decreased inflammation, neovascularization, and cellular proliferation
- The mechanism behind the pain relieving function of ESWT is thought to be due to increased serotonin activity in the dorsal horn, and descending inhibition of pain signals

- Treatment typically consists of 1–2000 shocks delivered in a session at 1–3 bar
- The shocks are delivered at 5–20 Hz (shocks per second), though there is no evidence that identifies a particular rate as being more effective.
- The effect of this type of treatment is provocative in nature.
- It stimulates an acute reaction in the tissues, taking the tissue from a chronic, unresponsive, recalcitrant state to a more responsive, acute lesion.

- ESWT is useful for;
  - Analgesia
  - Wound healing
  - Osteoarthritis,
  - Delayed and nonunion fractures,
  - Ligament and tendon diseases
  - Chronic wounds



Radial shock wave therapy for osteoarthritis in a dog

- Contraindications;
  - immune-mediated joint disease, infectious arthritis,
  - neoplastic disease,
  - diskospondylitis,
  - unstable fractures,
  - in dogs with neurologic deficits
  - to use near gasfilled cavities or an organ
  - over lung fields, brain, heart, major blood vessels, nerves
  - On a gravid uterus

MAGNET THERAPY

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- Magnet therapy has been used in human medicine as an alternative therapy for many years.
- It has gained popularity more recently in veterinary medicine.
  - Static Magnet Therapy
  - Pulsed Magnetic Field Therapy

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https://animaltherapeutics.com.au/wp-content/uploads/2016/02/activo-med-leg-wrap.jpg

Static Magnet Therapy

- Static magnets have magnetic fields that do not change.
- Static magnets for therapeutic purposes are usually in the 300- to 5000-Gauss.
- When used directly against the skin, static magnets will influence the bioelectrical composition of the tissue underneath.
- While the magnetic field generated is unchanging, the blood flowing through the tissue contains charged ions, which are drawn to the magnetic placement.
- It is thought to be usefull in joint stiffness, general tightness, muscle strains, bruising, localised swelling

Pulsed Electromagnetic Field Therapy

- Electromagnets generate magnetic fields only when electrical current flows through them.
- A magnetic field is pulsed through tissue fibres at a range of pre-set, variable frequencies.
- Electromagnetism is generated by running an electric current through a coiled wire (electromagnetic induction).
- PEMFs are hypothesized to have electric rather than magnetic effects on tissue

- Main therapeutic purpose of PEMFT is enhancement of bone or tissue healing and pain control.
- It may stimulate new bone growth, pruduction of glycosaminoglycan
- At 15-16 Hz, calcium ion transport occurs and cartilage growth is stimulated, perhaps because of increased transcription and DNA synthesis.

- It can be used for;
  - Wound healing (chronic)
  - Osteoarthritis
  - Delayed fractures or non-union
  - Relieve pain

https://www.westsideanimalhospital.com/blog/wp-content/uploads/2019/06/pemf.jpg

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PHYSICAL THERAPY and REHABILITATION of SMALL ANIMAL ORTHOPEDIC and NEUROLOGIC DISEASES

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Physiotherapy of Orthopedic Diseases

- Soft tissue lesions like as muscle, tendon and ligament injuries; osteoarthritis; fractures and hip dysplasia are the most common orthopedic disorders which can be treated with pyhsiotherapy.
- Soft tissue injuries are an often underdiagnosed source of canine lameness.
- Sporting and working dogs may be particularly at risk of suffering acute traumatic muscle strains, ligamentous sprains or chronic overuse degenerative tendinosis lesions resulting from poor healing of repetitive strain injuries.

Rehabilitation example for grade one cranial cruciate ligament injuries

- Clinical symptoms; mild swelling detectable at the parapatellar tendon, mild discomfort on stress testing (unanaesthetised), partial weight-bearing use of limb.
- Treatment suggestion;
  - ✓ Keep the dog on a leash for 2–3 months without exception.
  - ✓ Modalities that may encourage circulation to the cruciate ligament; you can use PEMF or laser on a regular basis

- ✓ Joint proprioception techniques such as joint compressions and cross-leg standing.
- ✓ Strengthening of the adjacent musculature: up-hill walking (steep going up and gradual coming down).

https://files.brief.vet/migration/article/25256/kirby_image1-25256-article.png

- ✓ Balancing/coordination: walking on different terrain (i.e. To cause high stepping or somewhere with uneven footing), rocker boards, mini-trampolines, obstacle course and cushions off the couch, etc.
- ✓ At 2–3 months (individually based): add some ‘destination jumping’ (i.e. onto a bed or couch or over a small jump) and/or tug-of-war exercises if the dog is safe doing so.

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- ✓ At 2–3 months (individually based): add some ‘destination jumping’ (i.e. onto a bed or couch or over a small jump) and/or tug-of-war exercises if the dog is safe doing so.
- ✓ Supplementation: glucosamine HCl and methylsulphonyl methane (MSM)

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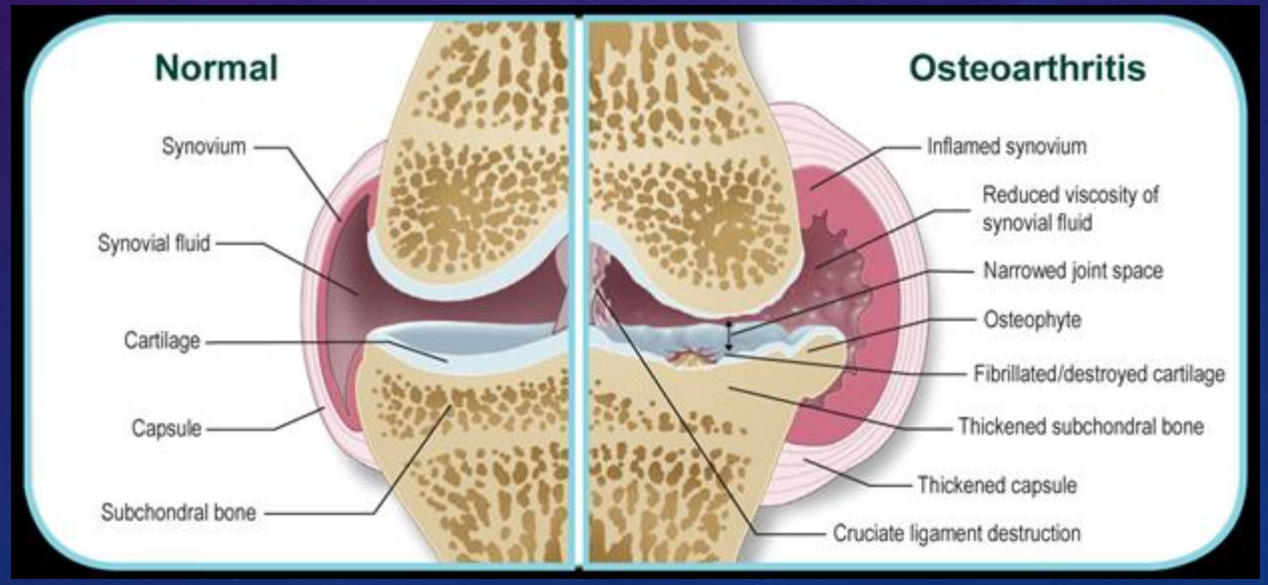
- ✓ Owners must avoid throwing balls or playing ‘Frisbee’ with their dog for 4–6 months
- ✓ Return to normal off-leash activity should be addressed with advanced-level neuromuscular retraining

https://www.dogingtonpost.com/wp-content/uploads/2013/10/frisbee.jpg

Rehabilitation of osteoarthritis

- Osteoarthritis is characterised by progressive loss of articular cartilage, reactive changes at the margins of the joints and bones, and chronic joint inflammation.



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- Clinical symptoms;
  - ✓ aching discomfort that worsens with activity and is relieved by rest,
  - ✓ a restriction of activity level, a limitation in the ability to perform,
  - ✓ poorer proprioception, pain and discomfort,
  - ✓ joint stiffness, effusion and enlargement,
  - ✓ loss of strength and flexibility.

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- The goals for the treatment of OA;
  - improve the joint and overall function and quality of life of the animal,
  - relieve pain and associated muscle spasm, maintain and regain joint ROM,
  - improve joint health, strengthen supporting muscles,
  - address proprioceptive deficits and advise on lifestyle modifications.

- Pain relieving can be provide by use of modalities; ultrasound, laser, PEMFT, ESWT and NMES
- Massage may reduce pain, increase pain tolerance and stimulate a release of endorphins, so long as regular massage sessions are administered
- Thermal agents such as heat or cold are both reported to have pain-relieving effects and application of each should be taught to owners and/or utilised as part of a therapy session

- Manual physiotherapy techniques such as joint mobilisations, stretching and joint traction/distraction should be a part of therapy
- Weight management should be an integral part of rehabilitation of the osteoarthritic dog.

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Physiotherapy of fractures

- Physiotherapy applications can be performed when the area is accessible (i.e. when a bandage or cast is off) or immediately if an internal fixation has been used.
- Aims;
  - ✓ pain management,
  - ✓ aerobic fitness,
  - ✓ avoidance of complications related to immobility or reduced muscle mass,
  - ✓ strengthening and retraining functional ctivities

- Low-intensity, pulsed US can be used to stimulate endochondral ossification due to stimulation of bone cell differentiation and calcified matrix production by intracellular calcium signalling and incorporation in chondrocytes

- 0.03–0.05 W/cm2 with a 1.0 MHz or 1.5MHz or 3.3MHz sound head used for 10–20 min per session daily, beginning day 1 post operative is suitable for fracture repair

- US is also effective on delayed unions and non-unions

https://www.jbjs.org/rsuite/php/dbapi.php?operation=loadImage&a0=272785

- Laser therapy is effective on bone healing.
- 830 nm, 40mW, continuous wave × 16 J/cm2/session, divided 4 points around the defect (4 J/cm2) – starting immediately after surgery and repeated 7 times, Q48 h (Gerbi et al. 2005).
- 830 nm, 0.5 cm2 area × 50 mW x 10 J/cm2 (fractioned into 4 points), Q48 h (Weber et al. 2006).
- 632.8nmlaser, 35mW, for 30 min, delivering 892 J/cm2 cumulative over 14 days (63 J/cm2 per day) (Luger et al. 1998).

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- Pulsed electromagnetic field (PEMF) has been reported to stimulate the activity of osteoblasts and chondroblasts, but its effect on bone healing is still controversial
- In one study it was reported that a PEMF setting of 1.5 Hz for 1 h/day at 4 weeks postoperatively and lasting for 8 weeks significantly increased stiffness and promoted greater new bone formation (Inoue et al. 2002).

- NMES has been shown as effective on promoting bone healing in different studies.
- ESWT is a newer therapeutic modality and its useful effect on non-unions/delayed unions was reported in studies.
- Controlled weight-bearing exercises were found useful

https://dogwheelchairlife.com/wp-content/uploads/sites/91/2020/06/Josie-Jen-Zarcone.jpg

https://strideseattle.com/wp-content/uploads/2017/11/canine-PT.jpg

Physiotherapy of Neurologic Diseases

- The main focus of neurological rehabilitation should be on functional gait retraining and development of the stereotypical patterns of gait.
- In some neurologic cases, spontaneous recovery of function may occur as a result of reduction in swelling or reabsorption of haemorrhage.
- Aims: To take advantage of spontaneous recovery; manipulate neuroplasticity to assist functional return; prevent or minimise complications; and implement compensatory strategies when poor prognosis results in the threat of euthanasia.

- Spinal cord disease; caudal cervical vertebral malformation (CCVM), Hansen's type I and type II intervertebral disc disease, fibrocartilaginous embolism, chronic degenerative radicular myelopathy (CDRM), inflammatory diseases involving central nervous system
- Peripheral nerve disease, e.g. traumatic peripheral nerve paralysis
- Generalised neuromuscular disease, e.g. polymyositis, tick paralysis, polyradiculoneuritis, tetanus
- Cranial nerve disease, e.g. trigeminal neuralgia, facial nerve dysfunction
- Vestibular disease
- Neuropathic pain

- active therapeutic exercises
- passive range of motion (PROM),
- massage, electrical muscle stimulation (NMES)
- Another important part of therapy is the therapeutic handling and functional positioning during resting periods

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https://www.ndsr.co.uk/library/img/www/specialist-information-sheets/orthopaedics/canine-pelvic-limb-physiotherapy/harness-and-abdominal-sling.jpg

- For intervertebral disc disease; PROM exercises, neuromuscular stimulation and functional weight-bearing exercises, balance and strengthening exercises as well as hydrotherapy (swimming or underwater treadmill).
- For fibrocartilaginous embolism; passive range of motion, massage, positional exercises, electrical stimulation, physiological positions, gait training with support and hydrotherapy.

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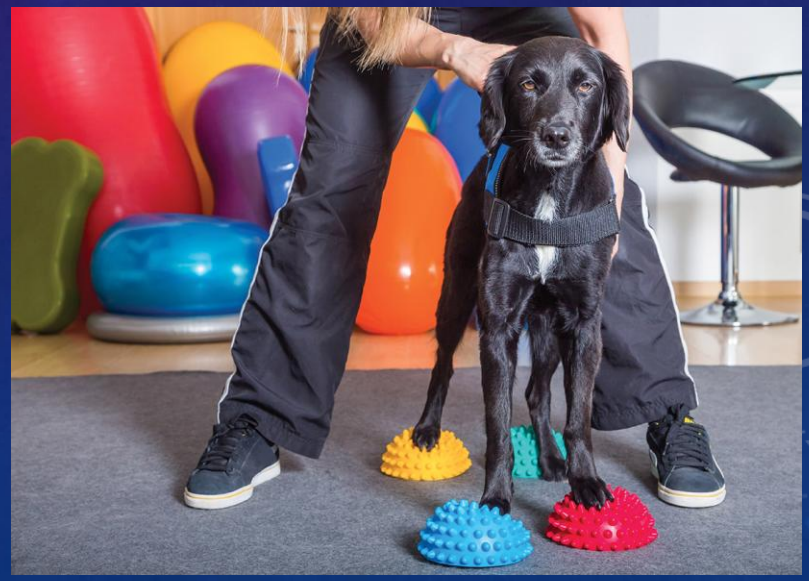

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- Educate the owners for evacuation of rectum and manuel expression of the bladder in patients with fecal and urinary retention
- Prevent decubitus ulcers
- Weight control
- Basic home therapy and care; PROM, active ROM, stretching exercise, assisted standing excercise, soft bedding etc.

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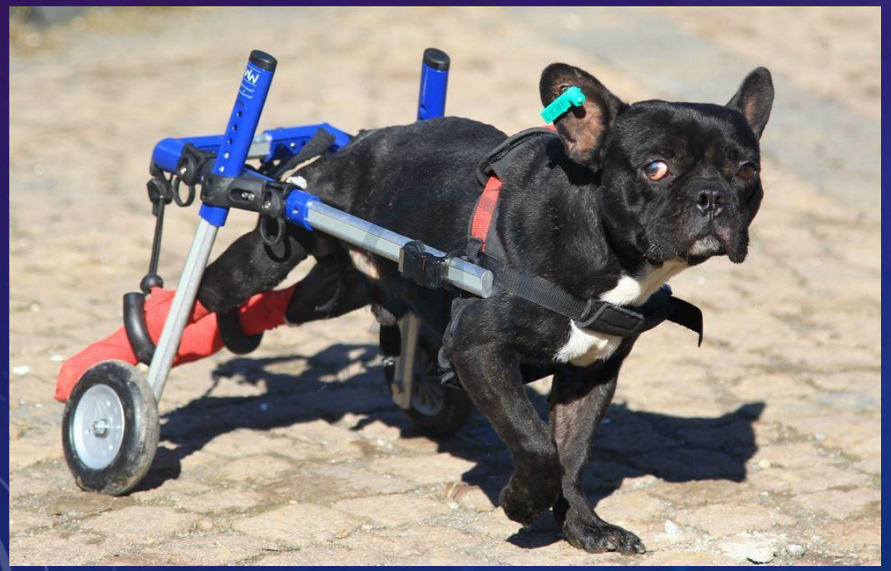

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