

Hanaa Mohammed



بسم الله الرحمن الرحيم

مركز الشبكات وتكنولوجيا المعلومات

قسم التوثيق الإلكتروني



Safaa Mahmoud



جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
على هذه الأقراص المدمجة قد أعدت دون أية تغييرات





Cairo University
Faculty of Veterinary Medicine
Department of Surgery, Anesthesiology and Radiology



Brief on Canine Carpal Arthrodesis (experimental study)

Thesis Presented by

Amr Hesham Ahmed

(BVSc, Cairo University, 2018)

For the Degree of Master's in Veterinary Sciences

(Surgery, Anesthesiology, and Radiology)

Under supervision of

Prof. Dr. Faisal Abdel Samad Mohamed Torad

Professor of Surgery, Anesthesiology and Radiology

Faculty of Veterinary Medicine

Cairo University

Prof. Dr. Ashraf Aly EL-Desoky Shamaa

Professor of Surgery, Anesthesiology and Radiology

Faculty of Veterinary Medicine

Cairo University

Dr. Ahmed Ismael Abdelgalil

Assistant Professor of Surgery, Anesthesiology
and Radiology

Faculty of Veterinary Medicine

Cairo University

2022



Cairo University
Faculty of Veterinary Medicine
Department of Surgery, Anesthesiology and Radiology



SUPERVISION SHEET

Brief on Canine Carpal Arthrodesis (experimental study)

M.V. Sc Thesis

By

Amr Hesham Ahmed

(B.V. Sc. 2018; Cairo University)

Supervision Committee

Prof. Dr. Faisal Abdel Samad Mohamed Torad

Professor of Surgery, Anesthesiology and Radiology
Faculty of Veterinary Medicine
Cairo University

Prof. Dr. Ashraf Aly EL-Desoky Shamaa

Professor of Surgery, Anesthesiology and Radiology
Faculty of Veterinary Medicine
Cairo University

Dr. Ahmed Ismael Abdelgalil

Assistant Professor of Surgery, Anesthesiology and Radiology
Faculty of Veterinary Medicine
Cairo University

Name: Amr Hesham Ahmed
Date of Birth: 04/06/1995
Place of Birth: Menofia
Nationality: Egyptian
Specialization: Surgery, Anesthesiology and Radiology
Degree: Master's Degree (M.V. Sc)
Title of thesis: Brief on canine carpal arthrodesis (experimental study)

Under supervision of:

Prof. Faisal Abdel Samad Mohamed Torad

Professor of Veterinary Surgery Anesthesiology and Radiology, Faculty of Veterinary Medicine, Cairo University.

Prof. Ashraf Aly EL-Desoky Shamaa

Professor of Veterinary Surgery Anesthesiology and Radiology, Faculty of Veterinary Medicine Cairo University.

Dr. Ahmed Ismael Abdelgalil

Assistant Prof. of Veterinary Surgery Anesthesiology and Radiology, Faculty of Veterinary Medicine Cairo University.

ABSTRACT

A novel application of mesenchymal stem cell-derived microvesicles (MSC-derived MVs) with arthrodesis in dogs is described, radiographic osseous union, lameness score, histological findings, and complications following surgery are assessed. This study compared the procedure type in 20 cases of pan carpal arthrodesis in a canine model. 20 apparently healthy mongrel dogs of both sexes, 1 -2 years old were randomly allocated in four main groups; 5 animals for each; Group I: cancellous bone graft group BG (treated with pan carpal arthrodesis and received autologous bone graft) Group II: mesenchymal stem cell-derived microvesicles group MVs (treated with pan carpal arthrodesis and received MSCs derived MVs only) and Group III: mixed group (treated with pan carpal arthrodesis and received cancellous bone graft seeded with MSCs derived MVs). Another group is the control negative group (received nothing). that's only treated with pan carpal arthrodesis without receiving any healing enhancement material. Radiographs were reviewed at 4, 8, and 12 weeks after surgery to compare the score of the radiographic osseous union. and the obtained results showed that group 2 (MSCs derived MVs) had a higher radiographic score than other groups followed by the mixed group while the (Bone Graft) and (control) groups show the lowest scoring. The BG group had significantly more major complications that required re-operation for implant removal or treatment of a deep infection compared to the other groups. Overall, mesenchymal stem cell-derived microvesicles may be used to augment arthrodesis in dogs without significant morbidity.

Keywords: arthrodesis, pan-carpal, microvesicles, stem-cells.

Acknowledgment

Firstly, Praise is to Allah for all His blessings and for granting me the knowledge, effort, and patience throughout my dissertation.

I would like to express my gratitude to Prof. Faisal Abdel Samad Mohamed Torad, professor of Surgery, Radiology, and Anaesthesiology, Faculty of veterinary medicine, Cairo University for his supervision, valuable consultation, and comments throughout my work.

I would like to thank Prof. Ashraf Aly EL-Desoky Shamaa, professor of Surgery, Radiology, and Anaesthesiology, Faculty of veterinary medicine, Cairo University for his supervision and valuable contribution throughout my work.

I would like to thank Dr. Ahmed Ismael Abdelgalil, Assistant professor of Surgery, Radiology, and Anesthesiology, Faculty of veterinary medicine, Cairo University for his supervision and guidance throughout my work.

Many words of gratitude and appreciation to all my colleagues and staff members of Surgery, Radiology, and Anaesthesiology for their incorporeal support, helpful contributions to surpass the obstacles during my dissertation

Thanks to my colleagues and lovely friends, especially those who helped and encouraged me.

Finally, I would like to express my appreciation and gratitude to my beloved family members for their patience, help, and encouragement, especially to my kind parents who supported me too much during this work, may Allah bless them more, grant them the best life and accept their good deeds.

Dedication

*To my family (Dad, Mum, sisters, and brother),
to say thanks seems so small but, thanks for
everything... their continuous support,
encouragement, and helping me.*

Contents

<i>Chapter</i>	<i>Page</i>
Chapter (1): Introduction	1-2
Chapter (2): Review of Literature	3-18
Chapter (3): Papers	
3.1. Enhanced Canine Carpal arthrodesis using Mesenchymal stem cell-derived microvesicles, in an experimental canine model.	19-67
3.2. Augmentation of carpal arthrodesis using mesenchymal stem cells derived microvesicles and cancellous bone graft in dogs.	68-79
Chapter (4): Discussion	80-83
Chapter (5): Conclusion	84
Chapter (6): Summary	85-86
Chapter (7): References	87-93
الملخص العربي	1
المستخلص	

List of Abbreviations

Abbreviation	Complete words
MSCs	Mesenchymal stem cells
MVs	Microvesicles
BG	Bone graft
AC	Antebrachio Carpal
ACB	Accessory Carpal Bone
PCA	Pan Carpal Arthrodesis
PtCA	Partial Carpal Arthrodesis
DCP	Dynamic compression plate
CLP	CastLess plate
HDCP	Hybrid dynamic compression plate
LCP	Locking compression plate
CESF	Circular external skeletal fixation
RC	Radiocarpal
IC	Intercarpal
CM	Carpometacarpal
CPM	Calcium phosphate matrix
Rh BMP	Recombinant human bone morphogenic protein
BMP	Bone morphogenic protein
DBM	Demineralizes bone matrix

Figure No.	Figure title	Page No.
<i>Figures of Paper- I</i>		
1	Aseptic limb preparation.	28
2	Dorsal skin incision over the dorsal aspect of the distal third of the radius and extending laterally to the Accessory cephalic vein to the distal metacarpal bone.	28
3	The abductor pollicis longus muscle is identified and then divided as it passes over the extensor Carpi radials, both tendon sheath of extensor Carpi radials and common digital extensor were opened along its entire length cephalic vein and adductor.	29
4	Once capsules were incised allow access to the joint of the carpus after this surgical site was exposed showing both distal radius, carpal bone, and metacarpal carpal bone.	29
5	All the articular cartilage was removed using an oscillating bone saw. Then lavaged the surgical site with an Adequate amount of sterile saline solution to reduce the risk of thermal necrosis.	30
6	All the articular cartilage was removed using a pneumatic drill then lavaged on the surgical site with an Adequate amount of sterile saline solution to reduce the risk of thermal necrosis.	30
7	After the articular cartilage was removed, Penetrating the subchondral bone of the distal radius until bleeding occurs to create vascular channels.	31
8	(DCP 6 holes 3.5mm) was positioned dorsally over the distal radius, carpal bone and third metacarpal bone make ensure that the plate allows approximately 10-15 degrees of carpal extension with or without contouring plate.	31
9	Bone plate fixation, drilling with 2.7mm drill pit, measuring screw length by depth gauge, tapping of the holes by cortical tap 3.5mm, and screw driving by screwdriver and total screws fixation.	32
10	Normal plate position.	32
11	Harvested of cancellous bone graft.	33
12	Injection of Mesenchymal stem cells derived microvesicles group at the site of operation then followed by Closure of the surgical wound.	33
13	Closure of the surgical wound.	34
14	(A) photograph of a dog from GI at 4 days P.O. showing the operated limb was covered by a bandage (B) photograph dog from GI at 4 weeks P.O. showing non-weight	37

	bearing lameness.	
15	(C) photograph of a dog from GI at 6 weeks P.O. showing partial weight-bearing (Toe-touching lameness). (D) photograph of a dog from GI at 8 weeks P.O. showing Weight-bearing lameness, typically with distinct “head bob”.	37
16	(E) photograph of a dog from GI at 10 weeks P.O. showing Mild weight-bearing lameness noted with the trained eye.	38
17	(A) photograph of a dog from GII at 4 days P.O showing the operated limb was covered by a bandage. (B) Photograph of a dog from GII at 1-2 weeks p.o. showing non-weight bearing on the operated limb.	38
18	(E) Photograph of a dog from GII at 2-3 weeks P.O. showing partial to non-weight bearing on the operated limb. Toe touching lameness. (D) Photograph of a dog from GII at 4 weeks showing significant weight-bearing lameness.	39
19	(E) Photograph of a dog from GII at 6 weeks P.O. showing weight-bearing lameness typically with distinct “head bob”. (F) Photograph of a dog from GII at 8 weeks P.O. showing Mild weight-bearing lameness noted with the trained eye.	39
20	(G) Photograph of a dog from GII at 8-weeks P.O. showing Mild weight-bearing lameness noted with the trained eye. (Full limb function).	40
21	(H) Photograph of a dog from GII at 10 weeks P.O. showing full limb function in stress positions. (I) Photograph of a dog from GII at 10 weeks P.O. showing full limb function in stress positions.	40
22	(A) photograph of a dog from GIII at 4 days P.O. showing cleaning of an operated limb by anti-septic betadine. Photograph of a dog from GIII at 1-2 weeks P.O. (B). showing non-weight bearing on the operated limb.	41
23	(C) Photograph of a dog from GIII at 6 weeks P.O. showing Significant weight-bearing lameness. (D) Photograph of a dog from GIII at 8 weeks P.O. Weight-bearing lameness, typically with distinct “head bob”.	41
24	(G) Photograph of a dog from GIII at 10 weeks P.O. showing full limb function in stress positions. (H) Photograph of a dog from GIII at 10 weeks P.O. showing full	42

	limb function in stress positions.	
25	<p>(A) Photograph of a dog from GIV at 6 weeks P.O. showing Toe-touching lameness.</p> <p>(B) Photograph of a dog from GIV at 10 weeks P.O. showing Weight-bearing lameness, typically with distinct “head bob”.</p>	42
26	<p>(C) Photograph of a dog from GIV at 12 weeks P.O. showing full limb function in stress positions.</p> <p>(D) Photograph of a dog from GIV at 12 weeks P.O. showing full limb function in stress positions.</p>	43
27	<p>(A) Latero-medial (LM) post-operative (P.O) radiographic image of a dog of GI at 4 weeks showing adequate metal-implant stability i.e., the bone was fixed with 6 cortical bone screws, 3 placed on distal radius bone, 1 in radiocarpal bone, and 3 in the third metacarpal bone the joint space still clear with no visible mineralized (bone) tissue in the joint space.</p> <p>(B) Latero-medial (LM) post-operative (P.O) Radiographic image of a dog of GI at 8 weeks showing Cancellous bone bridging the joint space, but joint space still clearly visible.</p>	45
28	<p>(C) Latero-medial (LM) post-operative (P.O) radiographic image of a dog of GI at 12 weeks showing Bony bridging of joint space in both intercarpal and carpometacarpal joint. But the subchondral bone plate is still clearly visible. RC show filled with cancellous tissue but the joint space is still clear.</p> <p>(D) Latero-medial (LM) post-operative (P.O) radiographic image of a dog of GI after 16 showing Bony bridging of joint space but the subchondral bone plate appears to be disappeared.</p>	46
29	<p>(A) Latero-medial (LM) post-operative (P.O) radiographic image of a dog of GII showing adequate metal-implant stability i.e., the bone was fixed with 6 cortical bone screws, 3 placed on distal radius bone, 1 in radiocarpal bone, and 3 in third metacarpal bone. The forelimb was placed in a bandage.</p> <p>(B) Latero-medial (LM) post-operative (P.O) radiographs of a dog of GII at 4 weeks showing Cancellous bone bridging the joint space, but joint space still clearly visible.</p>	46
30	<p>(C) Latero-medial (LM) post-operative (P.O) radiographic image of a dog of GII at 8 weeks showing Bony bridging of joint space but the subchondral bone plate still clearly visible. In both intercarpal and carpometacarpal joint but non involve the radiocarpal joint.</p> <p>(D) Latero-medial (LM) post-operative (P.O) radiographic image of a dog of GII at 12 weeks showing Bony bridging of all joints</p>	47

	space	
31	(E) Latero-medial (LM) post-operative (P.O) radiographic image of a dog of GII at 16 weeks showing Solid fusion of adjacent bones with modeling of bone and loss of subchondral bone plate. (F) Latero-medial (LM) radiographic image of normal left carpal joint.	47
32	(A) Latero-medial (LM) post-operative (P.O) radiographic image of a dog of GIII at 4 weeks showing Cancellous bone bridging the joint space, but joint space still clearly visible in (IC and CM). (RC) joint space is still clear without any mineralized bone tissue. (B) Latero-medial (LM) post-operative (P.O.) radiographic image of a dog of GIII at 8 weeks showing Bony bridging of joint space but the subchondral bone plate still clearly visible in both intercarpal and carpometacarpal joints. Radiocarpal joint filled with cancellous bone only.	48
33	(C) Latero-medial (LM) post-operative (P.O) radiographic image of a dog of GIII at 12 weeks showing Bony bridging of all joints space. (D) Latero-medial (LM) post-operative (P.O) radiographs of a dog of GIII at 16 weeks showed Solid fusion of adjacent bones with modeling of bone and loss of subchondral bone plate.	48
34	Photomicrographs of a tissue section from all groups at 4 weeks	51
35	Photomicrograph of tissue section from all groups at 8 weeks	52
36	Photomicrograph of tissue section from all groups at 12 weeks	53
37	Photomicrograph of tissue section from all groups at >12 weeks	54
38	Latero-medial (LM) post-operative (P.O) radiographs of a dog of GI show radiographic signs of osteomyelitis as a post-operative complication after pan carpal arthrodesis.	58
39	Latero-medial (LM) post-operative (P.O) radiographs of a dog of GI show loss in distal screws.	58

Figure No.	Figure title	Page No.
<i>Figures of Paper-II</i>		
1	The surgical procedure of pan carpal arthrodesis. (a) A dorsal skin incision (b) incision of the joint capsules (c) exposure of the carpal joints using gelpi retractor (d) all the articular cartilage was removed with using an oscillating saw I The subchondral bone of the distal radius was penetrated using a pneumatic drill. (f) DCP 6 holes 3.5mm was contoured and positioned dorsally over the distal radius, carpal bone, and third metacarpal bone	77
2	Radiographic scoring of pan carpal arthrodesis showing score (0) No mineralized(bone) tissue seen in the joint space. Score (1) shows cancellous bone bridging the joint space, but the space of the joint is still clearly visible. Score (2) shows bony bridging of joint space but subchondral bone is still clearly visible.	77
3	Histopathological section stained by H&E. for all groups at fixed intervals time	78

List of Tables

Table No.	Table title	Page No.
Table of paper- I		
1	Lameness score of all groups.	36
2	Radiographic scoring of all groups.	45
3	Complications followed pan carpal arthrodesis in Group (G1).	56
4	Complications followed pan carpal arthrodesis in G2	56
5	Complications followed pan carpal arthrodesis in G3	57
6	Complications followed pan carpal arthrodesis in G4	57
Table of Paper-II		
1	The lameness score in animals' groups	79
2	The mean average of the radiographic score in animals' groups	79
3	The average percentage of the presence of minor complications	79
4	The average percentage of the major complications	79