Emu oil for osteoarthritic hand pain

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Emu Spirit®

Abstract

Objectives

To establish the effect of emu oil applied topically or ingested, on grip strength, tenderness and pain on people with osteoarthritic hands.

Method

A double-blinded, placebo-controlled, repeated measures design was used to compare the effects of emu oil against a placebo (canola oil) when: (a) applied topically, (b) ingested, or (c) both applied topically and ingested. Measures of grip strength and tender joint count were undertaken at baseline and after 8 weeks of continued treatment. Visual analogue scale measures of pain were recorded at baseline, and weekly, on the same day and time each week, for 8 subsequent weeks.

Results

There were no significant changes in grip strength or tender joint count, but the grip dynamometer was faulty, and so the grip strength data were invalid. At the end of the study (week 8), pain scores were statistically significantly lower in the emu oil users (mean of all groups) compared with the placebo oil users. The treatment effect was medium to large ($p = .02$, $F = 2.68$, $\eta^2 = .13$).

From week 4 onwards the pain scores reported by emu oil users (all groups) progressively reduced whereas the placebo oil users' pain scores fluctuated over time.

Conclusion

These results suggest that emu oil may be useful in the management of pain in people with OA of the hands. Clinically, practitioners are advised to forewarn clients that improvements might not be observed for the first 3 weeks of treatment.

Introduction

As early as 1860, Bennett, a London academic, reported that aborigines and early white settlers used emu oil to heal wounds, reduce pain and relieve various muscular disorders[1]. Since that time there has been much anecdotal evidence claiming benefits from treating with emu oil. One of these claims is that emu oil is effective in reducing the symptoms of arthritis.

Previous Research

This study compliments early Australian research [2,3,4], which established the anti-inflammatory qualities of emu oil in rats.

The effect of emu oil was compared to some commonly used anti-inflammatory drugs (ibuprofen and prednisolone). An emu oil preparation was shown to have anti-inflammatory activity equal to or greater than ibuprofen, one of the non-steroidal anti-inflammatory drugs (NSAIDs), [3] and equivalent to the corticosteroid prednisolone [2].

Whitehouse [5] reported that emu oil demonstrated "profound anti-arthritic potency, in some respects, resembling some of the powerful immunosuppressant drugs. . . for rheumatoid arthritis" (p. 3). Considering that it is 8 years since Whitehouse et al. reported these findings it is disappointing that more progress has not been made in examining the medicinal properties of emu oil. One of the recommendations from the study [3] suggested that further investigation into the anti-inflammatory activity of emu oil should be undertaken and that these studies should include human clinical trials at the earliest opportunity.

Osteoarthritis

Osteoarthritis (OA) is a disease characterised by biochemical, physical and histological abnormalities of cartilage and is the leading cause of pain and disability in the community [6]. Radiological evidence suggests that changes of OA are present in more than 50% of people over 65 years of age and almost 100% in people over 85 years [7]. The presence of inflammation appears to depend on the rapidity and severity of the osteoarthritis [8].

Systemic Drugs

Paracetamol is usually the analgesic of first choice because of its relatively low cost and safety. NSAIDs are usually only considered if paracetamol is inadequate because of associated gastric ulcer complications. COX-2 inhibitors (eg celecoxib (Celebrex®)) have similar efficacy to conventional NSAIDS with lower incidence of ulcer complications [9]. However the side effects of inhibiting prostaglandins' role in cartilage repair may be detrimental in osteoarthritis. The side effect of bone depletion in corticosteroid usage and the lack of evidence of florid acute inflammation in OA, means that most practitioners are reluctant to prescribe corticosteroids for long-term treatment of osteoarthritis.

Glucosamine sulphate is a non-prescription drug that has been shown to have a 20-25% reduction of pain in patients with mild to moderate primary knee osteoarthritis. It may also slow radiological progression of the disease [10].

Because emu oil has been shown to have equivalent anti-inflammatory efficacy to NSAIDs and corticosteroids in rats [2], and because no adverse side effects have been reported with emu oil use, it has the potential to be effective in treating osteoarthritis in humans.

Emu Oil and Osteoarthritis Trials

There have been only two minor studies concerning emu oil and its effect on osteoarthritis in humans. Neither has been published in scientific or medical journals.

One is a preliminary project by Leahey from the Arthritis Clinic in Ardmore, Oklahoma. The study had 20 volunteers who had not used emu oil previously. They remained on the same arthritis medication. The study was for 2 weeks and 7 of the 12 emu oil users reported a significant reduction in pain, morning stiffness and swelling. One of the 8 placebo patients reported the same. A larger study over 3 months was proposed but not undertaken.

The second is an unpublished study by Ghosh and Whitehouse and showed a reduction in both pain and swelling in all volunteers suffering from arthritis after 17 days of consecutive topical emu oil applications. No control group was included in this trial.

Both of these studies were small clinical trials over relatively short time spans, and the details of methods used to measure results were not mentioned. The results gave some encouragement for further more rigorous scientific research.

This research project was undertaken to consider the potential benefits the anti-inflammatory qualities of emu oil may have for osteoarthritis sufferers.

Materials and Method

The trial was a double blinded, placebo controlled study as recommended by Chevallier [11] and was a six group repeated measures design with 120 participants.

Participants

The 120 volunteers were aged between 47 and 87 with a mean age of 62. They were recruited by advertising in "Update", the Arthritis Foundation of Victoria periodical, "The Herald Sun" newspaper and "Magic FM" radio station.

The participants were volunteers with hand osteoarthritis diagnosed by a medical practitioner. Volunteers with rheumatic diseases or other hand pathologies were excluded from the trial.

Most of the participants were taking medication for their arthritis and remained on the medication for the duration of the trial. No participants had used emu oil in the 12 months prior to the trial.

101 participants (79 female, 22 male) completed the trial.

Trial

Emu Spirit staff randomly allocated participants to one of six groups: -

1. Emu oil (Emu Spirit® Oil of Emu) applied topically (twice/day for < 30sec). (Emu oil analysis – App.1)
2. Placebo oil (Crisco® canola oil) applied topically. (Canola oil analysis App.2)
3. Emu oil ingested (5ml twice/day). (This oil has Therapeutic Goods Administration (TGA) listing as an ingestible product. App.3)
4. Placebo oil ingested
5. Emu oil applied topically and ingested
6. Placebo oil applied topically and ingested

Researchers and participants were blinded to group allocation. The taste and scent of the oils was disguised by the addition of edible lime oil. At the initial meeting all participants were shown how to apply or ingest the oil twice per day (morning and evening) and how to fill in the Visual Analogue Scale (VAS), by the student investigator.

Measures-

Pain

Pain was self-measured before the morning application, on days 1, 7, 14, 21, 28, 35, 42, 49 and 56 with a pain Visual Analogue Scale (VAS) (App 4). The VAS was chosen over other self-reported measures of pain because it is easy to administer, requires no special training, and was likely to be correctly used by participants even in the absence of specific direction from the researchers. The VAS has acceptable test-retest reliability (r = 0.87) for assessment of pain, and is an instrument with good validity, excellent reliability, moderate distribution-based responsiveness and good anchor based responsiveness compared to multi-item questionnaires [(12)]. Use of the VAS was explained to participants at the initial meeting. Measuring at the same time each day, before the morning application, avoided the influence of massage and any immediate effect from the topically applied emu oil. It also accounts for the influence of normal circadian rhythms on pain.

Tender Joint Count (TJC)

Fourteen joints on each hand were squeezed firmly. Any pain elicited meant a positive reading for that joint [(13)].

50 of the participants (Wed. Group 1) self assessed their joints at the beginning and end of the trial under supervision of the student investigator. The remaining 43 were assessed by student volunteers trained by the student investigator. Results were recorded on a diagram depicting two hands (App.5) by the placing of an "X" on the circle representing the tender joint. Both of these methods of evaluation are considered valid and adequate for research use [(13)].

Grip Strength.

Grip strength was assessed at the initial and final meetings. Two students were

instructed in use of a grip dynamometer and supervised participants. Right and left hand grip strength were tested and recorded. Test-retest results for grip dynamometers are excellent with ICC >0.91 in all instances. Hand-held myometry is easily performed in patients of various ages and muscle strengths, is a reliable measure of limb muscle strength, and can be used in longitudinal studies and clinical trials [14].

Statistical Analysis

All pre-post data were analysed using descriptive statistics and univariate ANCOVAs, in which the baseline scores for each variable were used as the respective covariate measures. Pain data was further analysed using a time plot, and a repeated measure ANCOVA, also with baseline scores as covariate. Repeated measures increase the statistical power of the analysis, but complicate the interpretation of results because of the interaction effect of the repeated measures [15]. Repeated measures results are included for the analysis of trends over time.

Results

Missing data

19 of the 120 participants did not complete the trial. Of those people who completed the trial, 13 did not complete both Grip Strength measurements, 2 did not complete all Pain Scale readings and 7 did not complete both Tender Joint Counts. For those that completed the trial any missing data was replaced with mean data for that group.

Tender Joint Count

There was no significant reduction in the tender joint count in those participants using emu oil compared to those using the placebo.

Grip Strength

Grip strength results were mixed and overall there were no significant differences between the emu oil users and the placebo groups. Groups B & C emu oil users (both groups were ingesting the oil) showed improvement in both right and left grip strength compared to the placebo users whilst in group A the placebo users showed more improvement. Group C emu oil users showed a significant improvement in grip strength on both left and right hands of approximately 20%. The grip dynamometer was found to be giving sporadically low readings at the second initial meeting. This was addressed by testing the dynamometer prior to each reading after the discovery of the fault. The sporadically low readings from the faulty grip dynamometer may have adversely affected results.

Pain

In the first three weeks of the trial there were no significant differences between the groups and the mean VAS recording for the emu oil and placebo oil users at the end of week 3 was 3.95.

After week 3 the readings for emu oil users gradually reduced until the final mean reading in week 8 of 2.57. The placebo users' readings continued to fluctuate and the final mean reading was 3.42. These readings were shown to be statistically significant in the pairwise comparison test with a medium to large effect size (p = 0.02, F = 2.68, $\eta^2 = 0.13$). The largest between groups difference occurred between group A placebo and emu oil subgroups where the final reading for the emu oil users was 2.07 and for the placebo group, 3.79.

VAS readings for emu oil and placebo oil users over 8 weeks

Discussion

Of the group A participants that applied the oil topically only, those using emu oil had consistently lower pain scores than the placebo users. A similar result did not occur with group C participants who applied the oil topically and also ingested the oil. Whilst all groups of emu oil users had downward trends in pain scale readings after week 3, groups A and B results were more significant than group C when compared to placebo. It is difficult to explain why both topical application and ingestion of emu oil had a more significant effect on reduction of pain when used alone than in combination. This result was unexpected and not consistent with anecdotal evidence that supports the use of emu oil both topically (for faster relief) and ingested (for longer term relief).

There was no significant difference in Tender Joint Count (TJC) readings between the emu oil users and the placebo group. This finding was not unexpected

as there was no grading of tenderness but a simple affirmative or negative to any pain elicited by the pressure applied. It is probable that emu oil is having an effect on one of the symptoms of arthritis (pain) but not on the status of arthritis.

In earlier trials, Whitehouse et al. [5] concluded that topical application (in rats) was more effective at reducing swelling than ingestion (though in this trial there was nothing to stop the rats from licking the topically applied oil). It was also shown that emu oil was more effective in rats when applied topically with a transdermal carrier, such as salicylate or eucalyptus oil to enhance skin permeation [4]. In this human trial the authors used pure emu oil to rule out any effect from the transdermal carrier. The massage time was limited to less than 30 seconds so that the effect from the massage

was also limited. Topically applied emu oil treatment may be more successful if the oil was combined with a transdermal carrier and was massaged more thoroughly into the skin. This is more relevant when the oil is more viscous as is the case during cold weather.

40% of the trial participants were taking NSAIDs (including COX-2 inhibitors). Vioxx® has now been withdrawn from retail because of an apparent increased cardiovascular risk. Recent research (CLASS trial) as reported by Fitzgerald [16] suggests that celecoxib (Celebrex®) did not differ from the traditional NSAIDs in its effect on the predefined gastrointestinal end points. Neither has it been exonerated from increasing cardiovascular risk. The non-specific NSAIDs cause gastric irritation in many patients. This combination of factors means that for some patients, emu oil may be a welcome alternative for treating pain associated with osteoarthritis.

Glucosamine sulphate taken orally for 3 months at a dose of 1500mg per day has been shown to be effective in reducing pain and slowing progression of mild to moderate osteoarthritis. Topical application may also be effective in reducing pain from the disease [9] OA sufferers may benefit from a combination of emu oil and glucosamine sulphate either taken orally or applied topically. Further research would be helpful to determine this.

In a 4 week trial by McCarthy & McCarthy [17] a capsaicin cream produced a 40% reduction in arthritic pain when compared to a placebo. A preparation combining emu oil and capsaicin may prove to be beneficial as a topical cream.

Pain was the measurement that showed statistically significant positive results for emu oil compared to the placebo. Because pain readings were still on a downward trend for the emu oil users at the completion of the trial, it would have been beneficial

to run a longer trial to ascertain the longer term effect on pain reduction by the emu oil.

Since the completion of the trial 5 participants have communicated with the student researcher to comment on post-trial effects. All had been on the placebo during the trial and had commenced using the emu oil post-trial. Each reported a reduction in pain, one claiming complete relief. Another reported some relief in hand pain but more substantial relief in pain from an osteoarthritic knee. This is consistent with other anecdotal claims that prompted this research.

Whitehouse et al. [5] revealed a large variation in anti-inflammatory activity of different samples of emu oil. Some possible influences included genetic background, nutrition, bird age and the type of rendering process used. It would be prudent in future studies to have emu oil tested for efficacy prior to the trial.

Research at Adelaide Royal Women's and Children's Hospital by Ferrante has been trying to develop a simple and effective method to identify the anti-inflammatory potency of the oil but as yet has not been successful. It would be helpful if eventually all retailed emu oil had a labelling system to identify anti-inflammatory potency.

It could reasonably be argued that the positive effect that emu oil has on reducing pain in hand osteoarthritis is due to its anti-inflammatory qualities. If this is true then it is probable that emu oil is more effective on osteoarthritis sufferers that have more extensive joint inflammation. Because other forms of joint disease such as rheumatoid arthritis generally display more signs of inflammation than osteoarthritis, it is probable that emu oil may be more effective in reducing pain in these arthritides.

Clinical Relevance

Emu oil, consistently ingested or topically applied may be effective in reducing pain in osteoarthritis sufferers after 3 weeks. Topical applications of emu oil may be a more effective treatment for osteoarthritis when combined with other products such as glucosamine and capsaicin. Heating emu oil reduces its viscosity, making it easier to ingest, particularly in cold weather when the oil thickens.

Emu oil is an animal product and therefore likely to be unacceptable to vegetarians.

Acknowledgements

Thank you to Emu Spirit® for supplying the emu oil used in the trial, for allocating patients to groups, for paying the cost of advertising and for assisting

with administrative chores such as answering phones and sending out information to participants.

Thank you to Crisco® for supplying the canola oil used as a placebo.

References

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Figures

Figure 1: Mean Visual Analogue Scale (VAS) readings for emu oil and placebo oil users over 8 weeks.

Appendix 1

Food Laboratories (Aust.) Pty Ltd

Sample:
Emu Oil
Batch No: ES031203
Tested On: 18/12/03
Report No: 283690

Moisture	0.1 %
Acid Value	0.5
Peroxide value	1.7 meq O_2/kg
Refractive Index	1.4635
Weight per mL	0.910 g/mL
Saponification Value	195.6
Ester Value	195.1
Totox Value	9.1
Iodine Value	64.1

Fatty Acid Profile:

C12:0	0.1 %
C14:0	0.4 %
C16:0	24.0 %
C16:1	4.4 %
C18:0	10.3 %
C18:1	51.0 %
C18:2	9.2 %
C18:3	less than 0.1 %
C20:0	0.2 %
C20:1	0.4 %

Microbiological Analysis:

standard plate count per mL (72h at 30°C)	less than 10

standard plate count per mL (5 days at 20°C) less than 10

Testing performed by chemist G.M. Brown, B.App.Sc. M.R.A.C.I,

Appendix 2

Crisco® Canola oil specifications:

Quantity per 100 ml	
Energy	3400Kj
Protein	0.0g
Fat, Total	92.0g
-saturated	8g
-trans	0.8g
-polyunsaturated	27.6
-monounsaturated.	55.6g
Omega 3	5.5
ALA	5.5g
Cholesterol	Nil
Carbohydrate	0.0g
-sugars	0.0g
Sodium	0mg

All specified values are averages.

Appendix 3

Therapeutic Goods Administration listing

Emu Spirit – Omega 369 Oil of Emu Capsules
ELF ID: 33057-23/08/2002-OE728-1

Item [27] Listing of Coded Indications

	Code	Description
1	ARTH1	Temporary relief of pain on arthritis (or) temporary relief of arthritic pain. [Warning S required] *
2	ARTH2	May help reduce joint inflammation associated with arthritis

* Warning S: If symptoms persist, seek medical advice

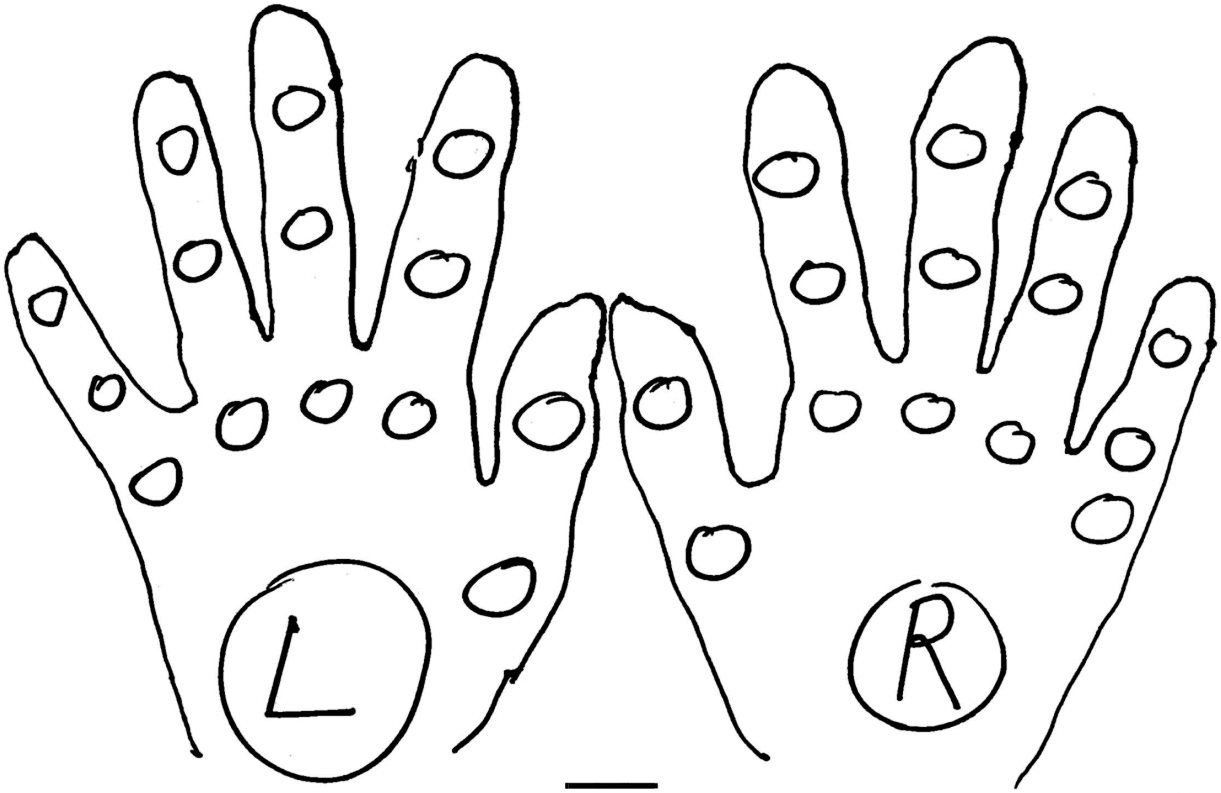
Appendix 4

Visual Analogue Scale – to be completed on Friday mornings. **4/6/04**

Please plot on the line the amount of pain that you are experiencing in the hands now.

I_____I
No pain Worst possible pain

Appendix 5



1st reading ____ **28**

Appendix 6

SPONSORSHIP AGREEMENT

I, _____

of _____

_____

agree to provide sponsorship for the clinical trial entitled:

The effect of emu oil on osteoarthritic hands

being conducted at Victoria University of Technology by:

Dr Melainie Cameron B.App.Sc. (Ost.), M.H.Sc. (Research)
Mr Ray Power B.Sc. (Clin. Sc.)

I agree to pay the full cost of: -

1. advertising space in Arthritis Victoria's *Update* magazine
2. expenses associated with employing a Call Centre to receive phone calls immediately after television exposure and to make four follow up phone calls.
   - to inform participants of the initial meeting time and place.
   - to remind participants to complete the Visual Analogue Scale
   - to monitor progress of participants and remind them to call the Principal Investigator if requiring assistance
   - to remind participants of the concluding meeting
3. emu oil used in the trial and gifted to the control participants after the trial

I agree that this sponsorship will not be used to influence the methods or results of this trial in any way.

I agree not to suppress publication regardless of the outcome of the study.

RAW DATA

I have been provided a copy of the Human Research Ethics requirements of Victoria University and the National Health and Medical Research Council (NHMRC), and agree to abide by the conditions set out in the guidelines. I am aware that I will not be able to access any raw data but that I will have access to de-identified tabulated data only. I am aware that in order to obtain raw data I will have to apply formally to Victoria University upon conclusion of the study.

Signed: _____ Witness: _____

Print name _____ Date _____
& position _____
_____
_____

Appendix 7

Participant Informed Consent Form

CERTIFICATION BY PARTICIPANT

I, _____of _____

_____

certify that I am at least 18 years old and that I am voluntarily giving my consent to participate in the study entitled:

The effect of emu oil on osteoarthritic hands

being conducted at Victoria University by:

Melainie Cameron B.App.Sc.(Ost.), M.H.Sc.(Research)

Ray Power B.Sc.(Clin. Sc.)

I certify that the objectives of the research, together with any risks and safeguards associated with the procedures listed hereunder, to be carried out in the research, have been fully explained to me by **Ray Power** and that I freely consent to participation involving the use on me of these procedures.

Procedures:

- Self massage of oil into hands or Ingestion of oil
- Written completion of Visual Analogue Scale
- Tender joint count
- Grip strength assessment

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential and that no personally identifying information will be available to anyone outside the research team.

Signed: _____ Witness (not researcher) _____

Date**:** _____

Any queries about your participation in this project may be directed to the researcher (Melainie Cameron (03) 9248 1149). If you have any queries or complaints about the way you have been treated, you may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone no: 03-9688 4710)

Appendix 8

INFORMATION TO PARTICIPANTS:

(a) Regarding:

The effect of emu oil on osteoarthritic hands

If you are over 18 years of age, have been diagnosed with osteoarthritis arthritis of the hand and have not used emu oil in the previous 2 months, you are invited to participate in the research project named above. Your current health professional will continue to provide medical care for you throughout the research period. Your current medication regime will not be changed.

(b) Aim.

The aim of this study is to assess the value of emu oil in treating hand osteoarthritis.

This study will determine whether emu oil, applied topically or ingested is effective in:-

- Reducing joint pain
- Reducing joint tenderness.
- Increasing grip strength.

(c) Method.

The participants will be volunteers over the age of 18 with diagnosed osteoarthritis in their hands. Participants with rheumatic diseases or other hand pathology, or who have used emu oil in the last 2 months, will be excluded from the trial.

Participants will be randomly allocated to one of four groups: -

1 Emu oil applied topically
2 Placebo oil applied topically
3 Emu oil ingested
4 Placebo oil ingested

The principal investigator will explain the details of the trial, how to apply or ingest the oil twice per day (morning, and evening), and how to fill in the Visual Analogue Scale (V.A.S) at an initial meeting at Victoria University.

The trial will last for 8 weeks and will measure the following: -

Pain – Self measured before the morning application, on days 0, 7, 14, 21, 28, 35, 42, 48 and 56 with a pain Visual Analogue Scale (VAS).

Tender Joint Count -Will be conducted at the beginning and end of the trial. The same person will conduct the two tests for each volunteer.

Grip Strength. -A dynamometer will be used to assess grip strength at the beginning and end of the trial.

(d) All participants who received the placebo treatment will be offered a complimentary 500ml of emu oil on completion of the trial.

No therapy is completely risk free. Concerted effort has been made to reduce the risks associated with the therapies used in this research project.

Participation in this project is voluntary. You are free to withdraw from the project at any time, without needing to provide a reason, and without fear of prejudice.

Any queries about your participation in this project may be directed to the researcher (Melainie Cameron (03) 9248 1149). If you have any queries or complaints about the way you have been treated, you may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone no: 03-9688 4710)

Appendix 9

March 29, 2004

Dear

Thank you for your interest in the clinical trial "The effect of emu oil on hand osteoarthritis".

Please find enclosed:-

- Details of the trial
- Consent form (please sign and bring to the initial meeting)
- Details of the initial meeting

There will be several initial meeting dates offered. The one to which you have been allocated is Thursday April 8 at 2.00 pm.

If this date does not suit or you won't be able to participate could you please call 9890 0073 or 1800 622212 and explain that you are calling regarding the osteoarthritis trial. We will try to arrange a suitable alternative date the following week.

Please bring a small carry bag (plastic bag will be fine) to take the oil home in.

Thank you in anticipation for your support of the trial.

Sincerely,

Ray Power B.Sc. (Clin. Sc.) Co investigator

The initial meeting will be held at Victoria University,
301 Flinders Lane, Melbourne
Level 1, Rm 1:11

Appendix 10

Faculty Human Research Ethics Committee

MEMORANDUM

TO: Dr Lainie Cameron (re: Ray Power)
Principal Investigator
HSc

FROM: Dr Dennis Hemphill
Chair
Human Research Ethics Committee
Faculty of Human Development

DATE: January 22, 2008

SUBJECT: **Approval of application involving human subjects**

Thank you for your submission detailing amendments to the research protocol for the project titled ***The effect of emu oil on osteoarthritic hands*** (HRETH.FHD.070/03).

The proposed amendments have been accepted by the Faculty Human Research Ethics Committee and approval for application HRETH.FHD.070/03 has been granted from 01/9/03 to 31/03/04.

Please note that, the Faculty Human Research Ethics Committee must be informed of the following: any changes to the approved research protocol, project timelines, any serious or unexpected adverse effects on participants, and unforeseen events that may affect continued ethical acceptability of the project. In these unlikely events, researchers must immediately cease all data collection until the Committee has approved the changes.

If you have any queries, please do not hesitate to contact me on ext 4486.

The Committee wishes you all the best for the conduct of the project.

Dr Dennis Hemphill
Chair
Human Research Ethics Committee
Faculty of Human Development

Appendix 11

Group	Base	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8
Emu A	3.90	3.67	3.47	3.53	3.27	3.20	3.60	2.20	2.07
Plac. A	3.96	4.02	4.07	3.58	4.17	3.65	3.92	3.83	3.79
Emu B	4.31	3.82	4.02	3.76	3.75	2.83	2.56	2.25	2.20
Plac. B	4.33	3.63	3.63	3.35	3.50	3.40	3.55	3.72	3.20
Emu C	3.82	3.97	4.36	4.44	3.86	3.50	3.42	3.36	3.31
Plac. C	3.43	3.71	3.46	5.25	3.71	3.71	3.64	3.50	3.07

Mean Visual Analogue Scale (VAS) readings for emu oil and placebo oil users over 8 weeks.

Appendix 12

NO.	AGE	DAY	GROUP	OIL	Grp	GRIP R1	GRIP R2	GRIP L1	GRIP L2	TJC1	TJC2	PS1	PS2	PS3	PS4	PS5	PS6	PS7	PS8	PS9	NSAIDS	GLUC
001	72	W1	A	E	1		8		11	12	13	4.5	3.5	3	3	2	2	3	2	3	Y	N
002	87	TH	B	E	2					0	3										N	N
003	73	TH	C	E	3	10	11	10	21	12	7	8	5	3	6.5	2	2	3.5	3	3	N	N
004	77	TH	A	P	4	30	27	30	38	3	2	4.5	4.5	4.5	4.5	6	6	6	6	6	N	N
005	64	TH	B	P	5	22	15	13	13	6	5	9	9	8	7	9.5	9	8	7	7.5	N	Y
006	67	W1	C	P	6	17	4	20	11	4	12	7	7.5	5	5	8	2.5	2	2	2	Y	N
007	47	TH	A	E	1	32	35	33	37	0	2	1	1	2	2	2	1	1	1	1	Y	N
008	71	TH	B	E	2	25	18	30	27	15	9	3.5	3.5	3	3	3	2.5	2	2	1.5	N	Y
009	62	TH	C	E	3	24	15	20	16	8	6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	N	N
010	70	TH	A	P	4	30	20	28	30	6	5	2	1	1	0.5	0.5	0.5	0	0	0	N	N
011	72	W1	B	P	5	21	18	36	28		5	5	5	5	4.5	4.5	4.5	4.5	4.5	4	Y	N
012	49	TH	C	P	6	21	9	22	15	8	10	2.5	1.5	1	1	1	2	1	3	2	N	N
015	65	W1	C	E	3	22	25	12	27	10	7	1.5	2	3	1.5	2.5	2	2	1.5	1.5	N	N
016	59	TH	A	P	4	20	8	28	20	17	16	7	9	8.5	7	7	6	6.5	7.5	7	Y	N
017	65	W1	B	P	5	13	4	20	10	9	8	3.5	5.5	2.5	6	3.5	1.5	1.5	6.5	2	Y	N
018	54	TH	C	P	6	14	10	14	20	8	9	1.5	1	2	3.5	2	1.5	2	2	2	N	N
019	54	TH	A	E	1	12	6	15	9	7	1	1	0.5	1.5	0.5	0.5	0.5	0.5	0.5	0	N	N
020	66	TH	B	E	2	12	20	9	12	8	2	6	6.5	5.5	6	6	4	4	3	3	N	N
021	53	TH	C	E	3	32	25	35	40	8	10	5.5	5	5	5	4.5	4.5	5	5	4.5	N	Y
022	70	TH	A	P	4	16	10	21	24	13	10	2.5	2.5	2.5	2.5	2.5	3	2.5	2	2	N	N
023	60	TH	B	P	5	15	12	25	12	8	4	2	1	6	4	7.5	7.5	8.5	7.5	6.5	Y	N
024	79	TH	C	P	6	16	18	28	24	9	11	1	3.5	4.5	2.5	3	1.5	4	1.5	1	N	N
025	58	TH	A	E	1	15	5	5	6	14	10	7	4.5	4	7.5	6.5	8.5	8.5	5	4.5	Y	N

NO.	AGE	DAY	GROUP	OIL	Grp	GRIP R1	GRIP R2	GRIP L1	GRIP L2	TJC1	TJC2	PS1	PS2	PS3	PS4	PS5	PS6	PS7	PS8	PS9	NSAIDS	GLUC
027	50	TH	C	E	3	19	13	30	20	16	10	5.5	6	5	5	4.5	4.5	4.5	4	4	N	N
029	76	TH	B	P	5	18	16	22	30	2	1	4	4.5	4	5	5	6.5	5	7	5.5	Y	N
030	56	TH	C	P	6	22	22	22	23	3	2	3	1	0.5	0.5	3	4	3	2	0.5	N	Y
031	63	W1	A	E	1	21	21	25	26	1	0	1	0.5	0.5	0	1	0	0	0	0	N	N
032	70	W1	B	E	2	16	17	17	27	5	3	3	3	5.5	5	3.5	2.5	1	0.5	0.5	Y	Y
033	56	TH	C	E	3	24	25	35	39	12	6	2.5	3	3	2.5	2	2	2.5	2	2.5	Y	N
034	54	TH	A	P	4	20	12	25	16	12	11										N	N
035	61	TH	B	P	5					9	8	1	0	0	0	0	5	6	6	2	N	Y
037	60	TH	A	E	1	19	18	26	21	7	15	2.5	1.5	1.5	2	1.5	1	1	1	0.5	N	N
038	57	TH	B	E	2	16	12	8	12	9	13	2.5	2	3	0.5	0.5	0.5	0.5	0.5	0.5	N	N
039	60	TH	C	E	3	15	16	21	16	9	8	6	7	6	6	6.5	7	5	8	6	Y	N
040	53	TH	A	P	4	15	12	9	20	2	2	1.5	2.5	4	3.5	8	3.5	4	4.5	5.5	N	N
041	51	W1	B	P	5	21	20	16	15	2	2	2.5	5	3	3	2.5	3	2.5	2	3	N	N
042	67	W1	C	P	6					7	7	3	2	1	0.5	0.5	5	7	5	5	N	Y
044	61	W1	B	E	2	14	25	16	26	6	7	1	2	1.5	2	2	2	1	0.5	0.5	Y	N
045	58	W1	C	E	3	13	10	24	20	12	5	3	3	3.5	3	2	1	0.5	0	0.5	N	N
047	62	W1	B	P	5	4	6	13	11	16	17	8	6.5	6.5	6.5	5	5	6	6	5.5	N	Y
048	67	W1	C	P	6	18	20	18	17	3	3	4	6	6	6	6	6	6.5	6.5	6.5	N	N
049	72	W1	A	E	1	2	0	2	6	8	2	5	6.5	5.5	6	3.5	3.5	6.5	2	3	Y	N
051	70	W1	C	E	3	26	20	26	18	17	16	3	2.5	4	4.5	5.5	4	4	4	4	Y	N
052	73	W1	A	P	4	22	5	20	10	1	3	2.5	2.5	4	3.5	4.5	3	5	3	2	Y	N
054	57	W1	C	P	6	21	23	20	13	6	5	3.5	4.5	5.5	3.5	2.5	3	3	2.5	2	N	N
055	63	W1	A	E	1	2	8	2	14	14	10	8	8	7.5	7	6.5	7	8	4	3.5	Y	N
056	84	W1	B	E	2	4	4	5	16		1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	Y	N

NO.	AGE	DAY	GROUP	OIL	Grp	GRIP R1	GRIP R2	GRIP L1	GRIP L2	TJC1	TJC2	PS1	PS2	PS3	PS4	PS5	PS6	PS7	PS8	PS9	NSAIDS	GLUC
057	82	W1	C	E	3	6	6	5	9		4	4	5	4.5	4	4	4	4	4.5	4.5	Y	N
058	67	W1	A	P	4	8	13	24	19	0	1	0	0	0	0	0	0	2	0	0	N	N
059	70	W1	B	P	5	20	11	36	29	7	6	3	3	2.5	3.5	2.5	3	3	4	3	Y	Y
060	77	W1	C	P	6	0	0	0	0	9	15	3	3	3.5	33	3.5	3.5	3	3	3	N	N
062	62	W1	B	E	2	9	11	20	25	11	15	7.5	8	8	7.5	8.5	8.5	6	7.5	7	N	N
063	55	W1	C	E	3	15	5	18	11	25	23	6.5	4.5	8	8.5	8	7.5	3.5	3.5	3.5	Y	N
064	62	W1	A	P	4	20	9	16	11	9	6	10	10	10	9	9	8.5	8.5	8.5	8.5	Y	N
065	51	W1	B	P	5	19	11	20	20	6	6	1	1	1.5	1	3	3.5	1	1	2	Y	N
068		W1	B	E	2					8	7	2	2	3	1	3	1	2	1	1	N	Y
069	81	W1	C	E	3	20	23	28	25	8	5	2	2	2.5	2.5	3.5	3	3	3	3	Y	N
071	55	W1	B	P	5	16	12	20	21	9	2	1.5	1.5	1.5	0	0	0	0	0.5	0	Y	Y
072	56	W1	A	P	4	15	4	16	11	5	7	6	8	7.5	6	3	3.5	6	6.5	6.5	Y	Y
073	54	W1	A	E	1	9	13	17	7	14	3	7	7	6	6	6	6.5	5	3	2	N	N
074	63	W1	B	E	2					16	9	5	5	4	7	4	2	2	2.5	1	N	N
075	63	W1	C	E	3	18	20	14	20	14	7	8	8	10	10	9.5	9	9	8.5	8.5	Y	N
076	60	W1	A	P	4	26	26	26	35	0	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	N	Y
077	59	W1	B	P	5					3	3	2	2	1	0.5	0.5	0.5	0	0.5	0.5	N	N
078	65	W1	A	P	4					8	4	3	3	2	1.5	1.5	2	1.5	1.5	1	Y	N
079	67	W1	A	E	1	17	21	9	24	6	6	3	2	1	2	1.5	2.5	3	3	2.5	N	N
080	63	W1	B	E	2	11	17	14	20			4	2.5	3	3	4	2	2	2.5	2.5	N	N
081	62	W1	C	E	3	12	14	15	25			0.5	1	1	2	0.5	1	2.5	3	3	Y	N
082	59	W1	A	P	4					3	4	2	2	2.5	1	2	2	2	2	2	Y	N
083	61	W1	B	P	5	20	19	20	16	14	9	7	3.5	3.5	2	2.5	1	3.5	3.5	4	Y	Y
084	66	W1	C	P	6					28	27	3	3	2	2	2	3	3	3	3	N	N

NO.	AGE	DAY	GROUP	OIL	Grp	GRIP R1	GRIP R2	GRIP L1	GRIP L2	TJC1	TJC2	PS1	PS2	PS3	PS4	PS5	PS6	PS7	PS8	PS9	NSAIDS	GLUC
085	63	W1	A	E	1	18	6	17	14	8	6	2	2	1	1	0.5	0.5	3	1	0.5	Y	N
088	65	W1	A	P	4	15	18	25	25			8.5	7	8	7	7	7.5	7	8.5	8	Y	Y
089	50	W1	B	P	5	30	35	32	35	10	10	2	2.5	2	2	2	1	1	1.5	1.5	Y	Y
090	66	W1	C	P	6	12	10	9	14	1	1	7	5	7.5	8	6.5	5.5	5	5.5	5.5	Y	Y
091	71	W1	A	E	1	10	15	6	8	3	1	5	4	3.5	3	3	4	3.5	2.5	2	Y	N
092	64	W1	B	E	2	10	20	19	32	12	1	5.5	5.5	6	5	4	1.5	3	2.5	2	N	N
093	66	W1	C	E	3	28	19	6	14	6	5	10	9	7	6	5	4.5	4	2.5	2.5	Y	N
094	81	W1	A	P	4					11	8	6	5	6	5	7	8	8	6	7	Y	N
095	77	W1	B	P	5					2		2.5	2	3	3	3	2	2	2.5	2	Y	N
096	57	W1	C	P	6					16	8	1	1.5	3	2	2	3.5	3	2.5	2.5	N	N
098	56	W1	B	E	2	32	34	35	34	4	0	4.5	4.5	5	5	4.5	4	4	3.5	3.5	Y	Y
099	50	W1	C	E	3					10	9	3.5	3.5	6.5	7	5.5	4.5	4.5	5	4.5	N	Y
100	58	W1	A	P	4	16	23	21	32	5	4	6	4.5	4.5	4.5	4.5	3	2.5	2.5	2.5	Y	N
101	56	W2	B	P	5	22	26	30	28	4	7	6	6	5.5	4	4	3.5	3	1.5	1.5	N	N
102	60	W2	C	P	6	5	3	25	22	5	4	7	10	3	3.5	10	10	7	10	6	Y	N
103	58	W1	A	E	1	20	11	16	13	3	8	1	1	1.5	1	2.5	0.5	1.5	0.5	1.5	Y	N
104	61	W2	B	E	2	15	12	15	13	12	15	5.5	5	5.5	5	4.5	4	4	2.5	3	Y	N
105	63	W2	C	E	3	15	17	20	22	8	6	4.5	2	2.5	2.5	1	1	2	2	2	N	N
107	55	W2	B	P	5	20	18	35	22	7	6	2.5	3.5	3.5	3	3.5	3.5	2.5	2.5	2	N	N
108	50	W2	A	P	4	15	15	15	20	11	7	5.5	5	6	5.5	4.5	5.5	5	6	5.5	N	N
110	58	W2	B	E	2	35	12	35	21	4	4	4.5	3.5	3	2	4.5	4	3	1.5	3.5	N	N
111	51	W2	A	E	1	17	12	12	17	11	6	8	8	8.5	6.5	6	5	4	3.5	3	Y	Y
112	64	W2	A	P	4	16		16	17	9	4	7.5	3.5	0.5	1	6	2	3	3	3.5	N	N
113	50	W2	B	P	5	24	19	30	26	13	10	5	5	5	5	4	3.5	3.5	3.5	4.5	Y	Y

NO.	AGE	DAY	GROUP	OIL	Grp	GRIP R1	GRIP R2	GRIP L1	GRIP L2	TJC1	TJC2	PS1	PS2	PS3	PS4	PS5	PS6	PS7	PS8	PS9	NSAIDS	GLUC
114	70	W2	C	P	6					4	5	3	3	2.5	3	2.5	3	3	2.5	3	N	N
115	63	W2	A	E	1	20	18	15	17	9	11	2.5	5	5	5.5	6	5.5	5.5	4	4	Y	Y
117	54	W2	C	E	3	30	14	30	21	4	3	3	2.5	3.5	3	2.5	1	1.5	0.5	1.5	N	Y
118	52	W2	A	P	4	15	15	25	26	10	4	3	2	1.5	1.5	2	1.5	1	1.5	1.5	N	N
119	62	W2	B	P	5	20	16	30	20	9	9	5	3	4	4	3.5	3	6.5	6	6	Y	N
120	57	W2	C	P	6	28	26	22	23	1	2	1.5	2.5	3.5	1.5	1.5	1	1.5	1	2	N	N