RESEARCH

Comparison Between Classic and Light Touch Massage on Psychological and Physical Functional Variables in Athletes: a Randomized Pilot Trial

Gemma V. Espí-López, PT, PhD,* Pilar Serra-Añó, PT, PhD, Ferran Cuenca-Martínez, PT, MSc, Luis Suso-Martí, PT, MSc, Marta Inglés, PT, PhD

Department of Physiotherapy, Faculty of Physiotherapy, University of Valencia, Gascó Oliag Street, 5. 46010 Valencia, Spain

Background: Despite the general belief of the benefits and the widespread use of massage in sport field, there are limited empirical data on possible effectiveness of massage on psychological and physical functional variables.

Purpose: The main objective of the present study was to compare the effectiveness of classical and light touch massage on psychological and physical functional variables in athletes.

Setting: Athletic club of Valencia

Participants: 20 amateur athletes were recruited from two athletic clubs.

Research Design: A single-blind, randomized, pilot-placebo trial.

Intervention: The subjects were randomly allocated to two different groups: a) Massage group (MG) (n=10); b) Control group (CG) (n=10). The intervention period lasted one month (one session per week).

Main Outcome Measures: Assessment of the participants was performed at baseline and 24 hours following the completion of the intervention. Outcome measures included hip flexion, knee extension, and mood state.

Results: The results suggest that MG obtained better results on physical variables ($p < .05$). However, for both groups, trends suggest significant improvements in the overall mood state of the participants ($p < .05$).

Conclusion: Our results suggest that classic massage could be an effective intervention to improve functional physical variables in athletes. However, trends suggest that a light touch intervention could provoke improvements in physiological measures.

KEY WORDS: massage; mood disorders, athletes; flexibility

INTRODUCTION

Massage has been extensively used as muscle conditioning and therapeutic option in a long tradition with a widespread use, and has been defined as a mechanical manipulation of body tissues with rhythmical pressure and stroking for the purpose of promoting health and well-being.(1) Previous research has suggested some biomechanical, physiological, and psychological benefits of massage interventions, such as an performance recovery, reduced muscle tension or pain sensitivity.(2-4)

In the sport context, massage appear to have a positive influence on physical conditioning functional variables like flexibility, range of motion, or muscle spasm.(5,6) In this regard, the intervention on functional physical variables, especially flexibility, seems to be crucial to prevent injuries in athletics.(7) In addition, the fact that mood state affects physical and psychological well-being as well as performance in sports has been widely documented in the scientific literature.(8,9) Previous studies suggest that massage could increase the secretion of endorphins, dopamine, and serotonin, and reduce the levels of stress hormones, such as cortisol or epinephrine, the reduction of which can reduce anxiety, fatigue, stress, and improve mood states.(10,11) Indeed, several studies on the psychological effects of massage have concluded that it produces positive effects in the athletes performance and injury recovery.(3)

However, it is well known that some of the effects of massage may be due to nonspecific factors. Manual therapy may result in changes in neurophysiological function, such as a reduction in medullary excitability or in inflammatory markers, regardless of the technique or modality used.(12) On the other hand, it is well known that the patient's expectations and beliefs about manual therapy intervention may also play a role in the effects of massage.[13]

Despite the general belief of the benefits and the widespread use of massage in the sport field, there are limited empirical data on possible effectiveness of massage. It is possible that the effects commonly associated with massage, and the different techniques of classical massage, may be due to unspecific effects of manual therapy. The main objective of the present study was to compare the effectiveness of classic massage against light touch intervention on functional physical variables and mood state in athletes.

METHODS

Study Design

A single-blind randomized pilot trial was designed. The study protocol follows the Consolidated Standards of Reporting Trials (CONSORT) statement on randomized trials of nonpharmacological treatments.[14] All procedures were approved by the Human Research Ethics Committee of the University of Valencia (H1480696803077). This study was registered in the United States Randomized Trials Register on clinicaltrial.gov (trial registry number: NCT03178604).

Subjects

A total sample of 20 athletes was recruited from two athletic clubs. The athletes were considered amateurs, as they belonged to amateur clubs that did not engage professionally in sport, although they trained and competed locally.

Participants were recruited between June and August 2017. The inclusion criteria were as follows: (a) male and female amateur athletes aged 17 to 30 years. The exclusion criteria were: (a) previous surgery of the locomotor system in lower limbs; (b) musculoskeletal injuries in any part of the body that prevent practicing sports; (c) understanding or communication difficulties; and (d) insufficient fluency in the Spanish language to follow measurement instructions. All data were collected at the University of Valencia.

Informed written consent was obtained from all the participants prior to inclusion. All the participants were explained the study procedures, which were designed according to the ethical standards of the Helsinki Declaration.

Procedure

Participants were randomized in two groups: Massage Group (MG) (n = 10) and Control Group (CG) (n = 10). The intervention period lasted one month (1 session per week).

Participant assessment was performed twice: prior to the study and one day after finishing the intervention. All the treatments were applied in decubitus, on both legs, and on each muscle group, and following this order: quadriceps, hamstring, and gastrocnemius, thus starting at the anterior part and ending at the posterior part. All sessions were conducted immediately after intense training of the participants. This training was the usual one of the participants in their clubs, being similar between the participants and the different sessions.

The intervention was performed by a physiotherapist specialized in sports rehabilitation, with more than five years working with athletes through manual therapy. In addition, therapist was specialized in sports massage, with specific training and experience in this field.

In all the sessions, the participants were asked about possible discomfort caused by the treatment received. The treatment was performed in the sports installations of the clubs immediately after training. A comfortable and relaxed room was set up for the intervention. During the treatment, the therapist did not use music or talk to the patient, except as necessary, to avoid unspecific effects that could influence the results. Participants were asked to maintain normal habits but avoid caffeine or vigorous exercise at least 24 hours before the remaining assessments.

Blinding

First, participants were randomized in two groups through computer software by an external assistant who was blinded to the study objectives. In addition, the assessments were performed by a researcher who was blinded to the purpose of the study, and subjects were blinded to group allocation. Finally, a different researcher, blinded to the aim of the study, performed the data analysis.

Interventions

Massage group (MG)

Classic massage techniques were included. The sequence of techniques used was as follows: 5 min of effleurage, 10 min of petrissage, and 5 min of tapotement (20 min in total). The pressure exerted for the techniques was determined by the Watson pressure scale, using the highest levels of pressure (strong and deep pressure).[15] This procedure was repeated for each leg.

Control group (CG)

This group received a control intervention at the same time as the other group (20 min), maintaining only light touch with the participant without exerting any mechanical pressure, which corresponds to a light lotioning pressure.[15]

Primary Outcomes: Physical Functional Variables

Hip flexion

It was evaluated by the passive straight leg raise (SLR). Passive SLR was conducted using a procedure previously described by Hopper et al.[16] A knee extension splint (Richards splint) and an ankle-foot orthosis were applied to the left leg to maintain the knee in full extension and the ankle at a neutral plantar angle. An inclinometer was attached to a belt, which was placed around the pelvis at the level of the anterior superior iliac spine (Baseline Bubble Inclinometer; Fabrication Enterprises, White Plains, NY, USA). A second inclinometer was then attached to the Richards splint at the level of the knee joint line.[17] Three measures were collected for each leg. Subsequently, the mean between both legs was used for analysis. The units were expressed in degrees (°). During the test, the participants were positioned with their hands on the abdomen, cervical spine in a neutral position, and eyes closed. The SLR procedure has excellent intrarater reliability, with an intraclass correlation coefficient [ICC] of 0.93–0.97.[18]

Knee extension

Passive knee extension was measured as described by Hopper et al.[16] Each subject was positioned in supine with the right leg strapped to the plinth. A crossbar was used to maintain the right hip at 90° flexion. An inclinometer was placed in line with the fibula and the knee was passively extended until the subject perceived the first stretch in the hamstring. At this point, the measurement of the inclinometer was recorded. The units were expressed in degrees (°). The participants were positioned with their hands on the abdomen, cervical spine in a neutral position, and eyes closed. The same procedure was used with the left leg. Three measures were collected for each leg. Subsequently, the mean between both legs was used for analysis. The correlation coefficient was found to be 0.99.[19]

Secondary Outcomes: Psychosocial Variables

Mood state

Mood state was assessed using the Spanish version of the Profile of Mood States (POMS) questionnaire, whose reliability and validity have been demonstrated.[20] The POMS questionnaire has shown to be useful in different settings, particularly in sports.[8] It is composed of 48 items measuring six mood situations: Anger, Depression, Tension, Fatigue, Vigor, and Friendliness. Reliability coefficients (Cronbach's alpha) for the factors ranged from 0.76 (Friendliness) to 0.91 (Anger). Each item is assigned a numeric value following a Likert format, with 5 response alternatives with values between 0 (not at all) and 4 (extremely).

Patient and Public Involvement

This research was done without patient involvement. Patients were not invited to comment on the study design and were not consulted to develop patient relevant outcomes or interpret the results. In addition, it was not possible to invite the patients to contribute to the writing or editing of this document for readability or accuracy.

Statistical Analysis

The Statistical Package for Social Sciences (SPSS 22, SPSS Inc., Chicago, IL, USA) software was used for the statistical analysis. Standard statistical methods were used to obtain the mean and standard deviation (SD). Inferential analyses of the data were performed using two-way mixed multivariate analysis of variance (ANOVA), with an intersubject factor called 'group' having two categories (MG and CG) and a within-subject factor called 'treatment' with two categories (T0 and T1). Post hoc analysis was conducted using the Bonferroni correction provided by the statistics package used, and the effect size was calculated using Cohen's *d*. We also compared the age and the level of pain experienced between groups, using a one-way ANOVA to ensure that the two groups were similar at baseline. The type I error was established as < 5% ($p < .05$). Randomization was performed using a computer-generated random sequence table with a balanced two-block design (GraphPad Software, Inc., San Diego, CA, USA). Independent research generated the randomization list, and a member of the research team who was not involved in the assessment or treatment of the participants was in charge of the randomization and kept the list. Those included were randomly assigned to any one of the two groups using the random sequence list, ensuring concealed allocation.

RESULTS

A total of 20 amateur athletes were included in the present study and were randomly assigned to two balanced groups consisting of 10 subjects per group (Figure 1). No adverse effects were reported during interventions or testing of functional physical variables.

Descriptive Results

Both groups presented similar mean ages of participants, being 21.9 ± 5.5 for MG and 19.7 ± 2.4 for GC. Similarly, participants' gender was similar between both, as in MG the ratio between men and female was equal (50%), while in CG there were more male participants (60%). One way ANOVA did not show statistically significant differences in any of the baseline measurements between the two groups, except for the total POMS score ($p = .029$) (Table 1).

Functional Physical Variables

Regarding hip flexion, the ANOVA revealed significant differences during group*time ($F = 7.88$, $p = .012$, $\eta^2 = .305$) and time ($F = 47.09$, $p < .001$, $\eta^2 = .723$). The post hoc analysis revealed statistically

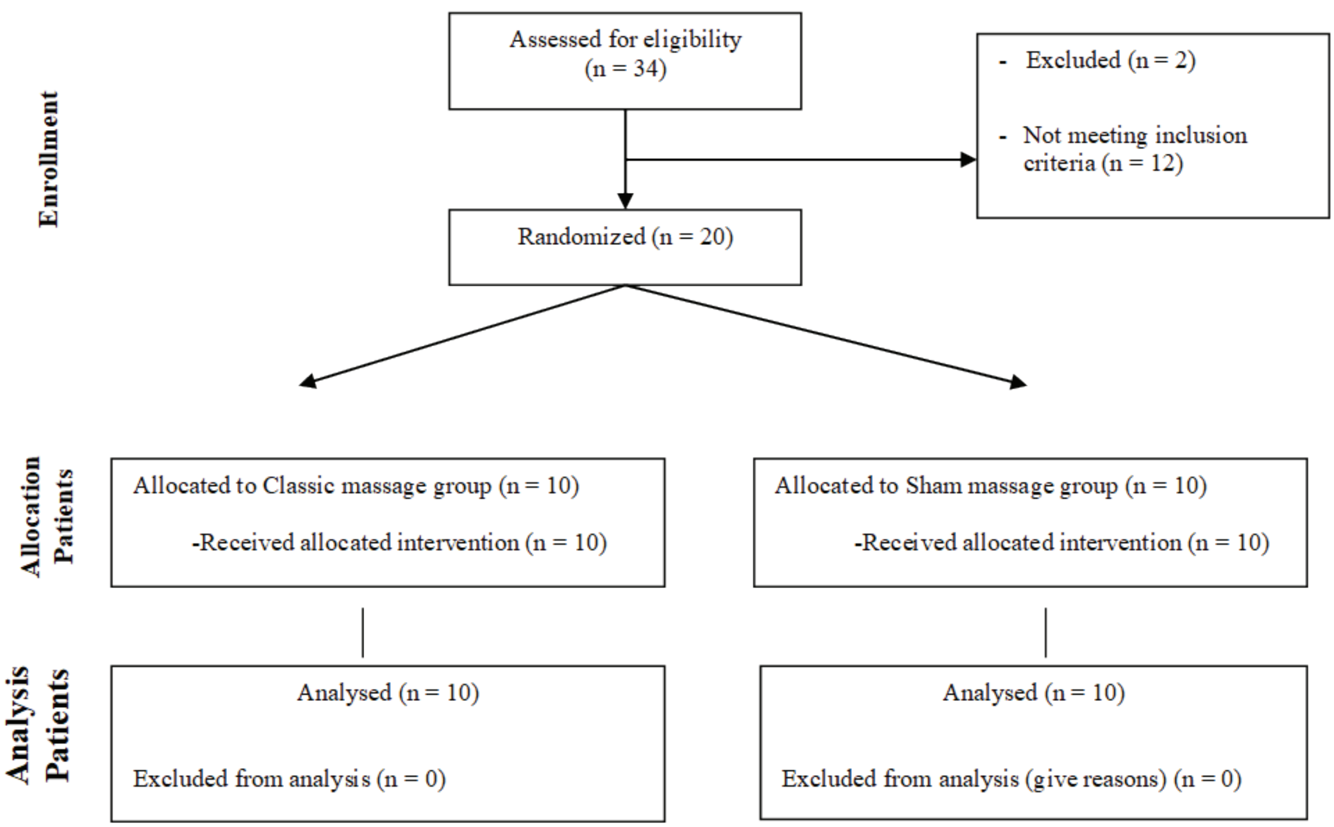

FIGURE 1. Flow chart according to CONSORT statement for the report of randomized trials.

TABLE 1. Summary of Baseline Measurements

Measure	MG[a] (n=10)	CG[a] (n=10)	p Value
Age (yrs)	21.9 ± 5.5	19.7 ± 2.4	.264
Gender			.653
Male	5 (50)	6 (60)	
Female	5 (50)	4 (40)	
Hip Flexion (°)	105.2 ± 14.38	111.8 ± 4.68	.185
Knee Extension (°)	19.8 ± 5.45	23.8 ± 12	.350
POMS–Total	51.7 ± 5.71	57.1 ± 4.38	.029[b]

[a]Values are mean ±SD and n (%).

[b]$p < .05$

CG = control group; MG = massage group; POMS = Profile of Mood States; ° = degrees.

significant within-group differences only in the MG with a small effect size ($p = .005$, $d = .23$). No significant between-group differences were found in both intervention groups ($p = .294$) (Table 2).

The ANOVA revealed significant changes in passive knee extension during group*time (F = 5.79, $p = .027$, $\eta^2 = .244$) and time (F = 6.95, $p = .017$, $\eta^2 = .279$). The post hoc analysis revealed no significant between-group differences in both intervention groups ($p = .627$). However, the post hoc analysis revealed statistically significant within-group differences only in MG with a small effect size ($p = .002$, $d = .19$), while these differences were not found in the CG group ($p = .873$) (Table 2).

Psychological Variables: The Mood State

Regarding the POMS scores, the ANOVA revealed significant differences in total score during time (F = 7.107, $p = .016$, $\eta^2 = .283$), but not for the group*time interaction (F = 0.22, $p = .644$, $\eta^2 = .012$). The post hoc analysis revealed significant between-group postintervention differences with a large effect size ($p = .037$, $d = -1.01$). In relation to the within-group differences, only the CG group revealed significant differences with a moderate effect size ($p = .04$, $d = .52$), while these changes were not found in the MG ($p = .902$) (Table 2).

In addition, due to the presence of significant preintervention differences, we directly compare differences between pre- and postintervention among groups (ΔCG at post–pre vs. ΔMG at post–pre). The ANOVA revealed no significant differences in total POMS score (F = .221, p = .644).

Sample Size Calculation

The sample size was estimated with the program G*Power 3.1.7 for Windows (G*Power© from University of Dusseldorf, Germany).[21] The sample size calculation was considered as a power calculation to detect between-group differences in a primary outcome measures (passive knee extension). We considered two groups and two measurements for primary outcomes to obtain 95% statistical power (1- β error probability) with an α error level probability of 0.05 using analysis of variance (ANOVA) of repeated measures, within-between interaction, and an effect size of $\eta_p^2 = 0.244$

TABLE 2. Within-Group Comparison Analysis

	MG (n=10)			CG (n=10)		
	Pre	Post	p Value Effect Size (d of Cohen)	Pre	Post	p Value Effect Size (d of Cohen)
Hip Flexion (°)	105.2 (14.38)	108.3 (13.3)[a]	$p = .05$ $d = 0.23$	111.8 (4.68)	112.1 (4.5)	$p = .07$ $d = 0.18$
Knee Extension (°)	19.8 (5.45)	21.6 (10.99)[a]	$p = .002$ $d = 0.19$	23.8 (12)	19.7 (5.16)	$p = .87$ $d = 0.02$
POMS–Total	51.7 (5.71)	50.3 (5.92)	$p = .90$ $d = 0.24$	57.1 (4.38)	55.1 (3.17)[a]	$p = .04$ $d = 0.52$

[a]$p < .05$

MG = massage group; CG = control group; POMS = Profile of Mood States; ° = degrees.

obtained from our results. This generated a sample size of a total of 30 participants plus an estimated 20% loss in follow-up, yielding a total of 36 participants (18 per group). In order to perform a future study, we used the data obtained in this research to conduct a sample size calculation.

DISCUSSION

The main objective of the present study was to compare the effectiveness of classical and light touch massage on functional physical variables and mood state in athletes. Our results suggest that only the MG was effective in improving physical functional variables. However, both interventions showed improvements regarding the mood state, but only in the CG was this change significant. These findings should be considered with caution due to the low sample size and the low statistical power derived from it.

Functional Physical Variables

There is scarce evidence regarding the effect of massage techniques on physical functional variables. Barlow et al.[22] carried out a study to evaluate the effects of effleurage and petrissage massage techniques applied to the hamstring muscle on the lower back flexibility in asymptomatic subjects. Although the results did not show statistically significant differences between groups, the authors noted that the subjects who presented a lower score in the preintervention Sit and Reach Test experienced a higher percentage of change after the massage intervention.[22] In addition, Hopper et al.[16] performed a study on female hockey players, applying effleurage, petrissage, and shaking massage techniques on the hamstring muscles. The results showed statistically significant short-term changes in the flexibility of said muscles measured using the passive knee extension test.[16] Similarly, Huang et al.[2] reported increased hip flexion following 10 or 30 sec of deep pressure massage on the hamstrings musculotendinous junction using a specific friction massage technique performed by a manual therapist, using the fingertips. In contrast, Jay et al.[23] found that superficial and shallow massage yielded no changes either in muscle flexibility or in range of motion. The authors postulated that the application of superficial massage might be insufficient to increase range of motion, whereas a deeper stimulus targeting the musculotendinous junction might be needed for this purpose.[23]

It has also been reported in the literature that, at the neurophysiological level, massage is able to induce a decrease in the excitability of motor neurons at the medullary level. This decrease is greater during higher deep maneuver techniques of massage; thus this might be related with the findings of the present study.[24,25] It has been suggested that the effects of massage may be explained in part by the mechanical pressure exerted during the intervention and not only for nonspecific effects, since this could stimulate improved muscular compliance and increase blood flow. These mechanisms may explain the improvements obtained both in the range of motion and in the hamstring muscles flexibility.[3]

Psychological Variables

Regarding psychological variables, participants within the CG showed significant improvements in the total POMS measure. However, it is necessary to take into account the limitations in the sample size, and to consider these results as trends that should be interpreted with caution.

These trends are related with previous research in the scientific literature, where massage applications has shown to produce an increase in the emotional state levels after the intervention.[26,27] Therefore, our results suggest that massage could be an effective strategy to improve concentration. This is especially relevant in the athlete population, since previous research has evidenced that concentration in sports can be a key factor to tackle competitive challenges, massage being a useful tool contributing towards success in the competition.[28,29]

The study conducted by Hemmings[30] reported that a massage intervention yielded statistically significant differences in terms of a decrease in the perceived tension, showing the positive psychological effects of massage compared to a placebo-based massage or non-intervention in boxers. In line with these findings, Li et al.[31] reported associations between high levels of anxiety and a higher prevalence of injury. In addition, Kennedy et al.[32] examined massage effect on psychological variables such as sleep, stress and quality of life in para-athletes. The results were consistent with the data obtained in the present study as they found that athletes' expectations, as well as the athletes' perception of the effect of massage, had an influence on the results obtained. These results may be comparable to our GC, where the psychological benefits associated with massage may have played a role in improving mood state.

Furthermore, Rapaport et al.[33] conducted a similar study comparing Swedish massage against light touch, and evaluated anxiety in patients with generalized anxiety disorder. The results showed that both groups improved in anxiety levels, regardless of the treatment group, although the group receiving Swedish massage had greater changes. It is possible that perceptions and expectations about massage are different among populations; this is an aspect that will be evaluated in future studies.

Despite the widespread use of massage in a sports context, the results of the studies analyzed showed that the simple fact of performing an intervention, even the lack of mechanical pressure, already had effects on the patient mood state, which enhances the significance of beliefs and expectations in the context of massage therapy.[12]

Limitations

The most relevant limitation of this study is the small sample size, due to the fact that this is a pilot study. Due to the low sample size and the multiple comparisons made, there is a risk of type I error, which must be taken into account when interpreting the results. However, the results are promising for continuing this line of research in a larger population. Another limitation is that the values of the overall POMS baseline assessment show statistically significant differences between groups, being higher in the CG. Lastly, it would have been interesting to measure aspects related to performance or prevalence of injury after the intervention.

CONCLUSION

Our results suggest that classic massage could be an effective intervention to improve functional physical variables and mood state in athletes. However, trends showed that a light touch massage intervention also produces significant improvements on physiological measures, and this should be considered. These results enhance the significance of beliefs and expectations in the context of massage therapy, but these findings should be considered with caution.

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CONFLICT OF INTEREST NOTIFICATION

The authors declare no conflict of interest, personally or related to funding.

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Corresponding author: Gemma Victoria Espí-López, PT, PhD, Department of Physiotherapy, Faculty of Physiotherapy, University of Valencia c/ Gascó Oliag Street, 5. 46010 Valencia, Spain

E-mail: gemma.espi@uv.es

The Architecture of Connective Tissue in the Musculoskeletal System—Often Overlooked Functional Parameter as to the Proprioception of the Locomotor Apparatus

Original Citation

Van der Wal, JC. The architecture of connective tissue in the musculoskeletal system—often overlooked functional parameter as to the proprioception of the locomotor apparatus. *IJTMB*. 2009;2(4):9–23.

In December 2009 (*IJTMB* Volume 2, Number 4), an article was published, titled *The Architecture of Connective Tissue in the Musculoskeletal System—Often Overlooked Functional Parameter as to the Proprioception of the Locomotor Apparatus*. Published online 2009 Dec 7. doi: 10.3822/ijtmb.v2i4.62

In this manuscript, it was proposed that traditional dissection anatomy is not the right tool to describe the functional organization of fascia and connective tissue, since the fascia and fascial structures are not about topography or anatomy, but may differ substantially in their architectural and 'mechanical' relationship with the muscle and bone tissue. This concept has major implications for understanding the organization of the substrate through which proprioception is communicated in the so-called musculoskeletal system. This organization cannot be described in terms of the usual discrete elements like muscles, bones, ligaments, tendons, and so on, but has to be described in terms of functional architecture relationships that this substrate (mechanoreceptors) has with fascia. Initially presented at the Second International Congress on Fascia Research (2009), the published paper was welcomed as an important shift in thinking about 'fascial anatomy'.

Although the article has been quoted many times, it was not until January 2020 that some quite essential errors in the figures' captions were brought to the author's attention by Prof. H. van Mameren, under whose supervision the research that the article is based upon was carried out. So, in good deliberation with the *IJTMB* editors, this commentary serves to correct the errors, and to honor belatedly the copyright of the figures as claimed by the rightholder of that time.

Corrected Captions (corrections in bold)

Figure 1. Opening of the antebrachial fascia **including retinaculum extensorum** in the distal **dorsolateral** region. Intermuscular loose areolar connective tissue revealed between the discrete muscle bellies and tendons. Left arm, dorsal side, lateral view.

Figure 2. The compartment of the third extensor digitorum muscle **is** opened **and partly** separated from the muscle fibers. **Proximally muscle fibers are still inserted to compartment walls**. Left arm, dorsal side, lateral view.

Figure 3. Proximal **medial** elbow region. Muscles are dissected away from the epicondylar connective tissue apparatus and reflected (to the **right**). **Also, on the medial elbow region,** muscle compartment walls **converge** toward the humeral epicondyle. Left elbow, **medial** view, **image left-right mirrored**.

Figure 4. Proximal **medial** forearm region. Muscles and muscular tissue have been removed. The most proximal extensions of the muscle compartment walls (the epicondylar connective tissue apparatus) are left in situ, demonstrating the muscle compartments converging to the **medial** epicondyle. Left elbow, **medial** view, **image left-right mirrored**.

Figure 5. (a) The "classical" in-parallel organization of the iuxta-articular tissue. From inside to outside: **articular capsule (blue)**; reinforcing iuxta-articular regular dense connective tissue structures (ligaments) (yellow); and on the outer side, periarticular muscle (red). *(b)* The "classical" organization principle of iuxta-articular connective tissue running from bone to bone, organized in parallel to the muscular component (tendons). Only in a particular joint position can the connective tissue transmit forces or signal in the sense of mechanoreceptor triggering (+++ versus – – –). **Blue: cartilage**.

FIGURE 6. *(a)* The alternative in-series organization of the iuxta-articular tissue. From inside to outside: **articular capsule (blue)**; periarticular regular dense connective tissue (yellow) in series with periarticular muscle (red). *(b)* The alternative organization of iuxta- articular connective tissue organized in series to the muscular component. In all joint positions, the connective tissue of the joint is brought to tension, and is capable of transmitting forces and signaling in the sense of mechanoreceptor triggering (+++ and +++). **Blue: cartilage**.

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Corresponding author: Jaap van der Wal, MD, PhD, Department of Anatomy and Embryology (retired), Faculty of Health, Medicine and Life Sciences, University Maastricht, Minderbroedersberg 4-6, 6211 LK, Maastricht, The Netherlands

E-mail: jaap.vanderwal47@kpnmail.nl