INTRODUCTION
In Ancient Greece, oil was costly and it was the responsibility of the gymnasiarch, a gymnasium official, to provide oil for the athletes during his period of office, and in many cases they shared their office with others in order to meet the cost of the oil. The importance of olive oil to the Ancient Greeks is highlighted by Aristotle, who wrote: “There are also ten Commissioners of the Games (Athlothetae) who provide the oil to the athletes. This oil is collected from the sacred olives (μορίαι). The Archon requisitions it from farm owners at the rate of three-quarters of a pint from each plant … When the Archon has collected the oil for his year of office, he presents it to the Treasurers to preserve in the Acropolis, and he may not take his seat in the Areopagus until he has paid the full amount to the treasurers. It is stored in the Acropolis until the Panathenaea (religious/sport festivals), when it is measured out to the Commissioners of the Games, who in turn distribute it to the victorious competitors”.

The ancient Greeks recognized the advantages of deep friction massage (DFM) of the body with olive oil. From the 8th century BC, athletes, particularly those active in wrestling and pangration, rubbed their bodies with oil or threw sand-dust (κόνιν) on them. In the initial stage of the massage, a dry rub was performed gently with the palm, a touch on the naked body of the exercisers that prepared the athletes physically and psychologically just before they entered the playing field. The rub (massage, Greek word from the ancient verb “masso = give assisting operations”) began at low intensity and progressively became stronger. In this way, the ancients aimed to achieve a gradual increase in the rate of metabolism, so the athletes’ bodies could respond in the best way to the required activity. The present report is based on classical Greek/Roman and related modern literature. In addition, the historical period in which the texts were written is examined.

HISTORICAL REVIEW
THE USES OF DEEP FRICTION MASSAGE WITH OLIVE OIL FOR THE PREVENTION/TREATMENT OF SPORTS INJURIES
Olive oil was so rare and valuable that managers of sports facilities stored and moved it in a special pot...
called an "aryballos". The "aryballos" was a round vase with a small orifice that could easily be corked. When an athlete was not aided by the aleiptes, he held the aryballos with one hand and brought his free hand with the palm upwards near to his mouth to receive the correct amount of oil and rubbed it into his body (Fig. 1). The elaiothesium of the gymnasium or of the wrestling ring was normally where the pots resided.

The existence of specialized sites in the foundation of gymnasiums is mentioned in the textbook of Vitruvius, "De Architectura": “In the double portico the following provision is to be made: the ephebeum is to be in the middle, which is in truth nothing more than a large exedra with seats and longer by one third than its width. On the right is the coriceum, and immediately adjoining it is the conisterium, near which, in the angle of the portico, is the cold bath, which the Greeks call λουτρόν. On the left of the ephebeum is the elaiothesium, which adjoins the frigidarium, from which a passage leads to the propigneum at the angle of the portico”.

The whole process of rubbing was performed in a specific part of sports institutions (Palaestra and Gymnasium), the “aleiptirion”. According to Aristophanes the massage was performed up to the umbilicus. An individual with special knowledge of human anatomy carried out the massage with oils. He was called the "aleiptes" or the "paidotrivis", or the "trainer", or was a co-athlete. According to Lucian, the rubbing actions were mostly mild and gentle in manner so as to avoid sudden movements that could cause injury to the soft tissue (muscle) of the trainee: “But in the beginning when they removed their clothes, I watched them spread themselves with oil and massage one another in a very friendly manner”.

Knowledge of human anatomy was required to ensure beneficial rather than harmful massage; theoretical and practical knowledge of the human body and its mechanisms was necessary so that an aleiptes could not only promote the mental health of the person who accepted his services, but also assist actively in the treatment of injuries. Characteristic of the therapeutic usefulness of the rub with olive oil is a reference in Patrologia Minge describing how the aleiptes could, through massage, reset the bone to articulate: “the dislocated limb is settled back into place through the art of massage”.

Rubbing with oil was considered so important in the ancient world that Philostratus in his book "Gymnastics-EPistolai" considered it necessary to provide instructions on how to conduct effective rubbing with olive oil. In particular, the great writer of antiquity wrote: “The trainer should treat the athletes in light and heavy events by rubbing with a moderate amount of oil, especially the lower parts, and should wipe them well”. The same author, stressing the positive effects (in the macrobiotic sense) of rubbing the body with oil, states: “they rubbed themselves with the oil of the wild olive. This style of living made them free from sickness and they retained their youth for a long time. Some of them competed in eight Olympic Games, others in nine; they were also excellent soldiers”.

Moreover, Philostratus believed that exercise combined with proper nutrition and rubbing acted positively, even preventing diseases. In particular he wrote: “The relationship between gymnastics and medicine is as follows: diseases such as catarrh, dropsy, phthisis and epilepsy are treated by doctors with stool, enemas or ointments and patches. Combined with exercise, proper nutrition and rubbing can be used to treat these conditions. However, where there is bruising, injuries, loss of vision or a dislocation, the gym cannot be used to cure these ailments and a doctor is required”.

Furthermore, Hippocrates, the Western father of medicine, in his work, Περί Διαίτης, refers to differences between exercises with oil and with dust: “LXV. Exercises in dust differ from those in oil; dust is cold, oil is warm. In winter oil promotes growth because it prevents the cold from being carried to the body. In summer oil produces excess heat. The flesh melts when it is heated by the sun, by the oil and by exercise. In summer it is exercise in dust that promotes growth more than oil as by cooling the body it prevents it being heated to excess. During winter dust is chilling or even freezing. Remaining in the dust after exercise during the summer benefits the athlete due to its cooling property for a short time. If the dust is on the body for a long time it dries the body to excess and renders it hard as wood. Rubbing with oil and water softens the body, and prevents it becoming over-heated”.

It is reported that the reasons why athletes rubbed their bodies with oil varied, making this a subject of analysis and open to various interpretations/theories. Some authors believed that rubbing with oil helped to raise the temperature of the body and led to increased flexibility (limber) of the muscles before exercise. Others thought that oil protected the body from the sun and other elements of nature; it was theorized that oil had heat-insulating characteristics. According to another

Figure 1. Red clyix. Illustration inspired by the commission of relaxation massage movements in the body of an athlete. An aleiptes is depicted kneading the muscles of a young athlete under the supervision of the trainer. Around 480 BC (the picture is from the book "The Olympic Games in Ancient Greece" edited by the Inspector General of Antiquities Giallouris Nikolaos, Athens 1982, p. 120). Rome, Villa Giulia. Photo M. Pucciarelli.
theory the oil produced a glistening body that was aesthetically pleasing and desirable, or that coating with oil prevented the loss of body fluids during exercise (protection from dehydration).13

Pliny believed that the oil protected the body against the cold.13 Massage with oil was so important that the nomenclature of two sport professions (“paidotrivis” = boy rubber and “aleiptes” = oiler) came from it.1 For wrestlers and pangratiasts, olive oil had the added function of reducing skin abrasion and preventing dirt from becoming packed into the pores of the athletes’ skin.1

The fact that Ancient Greeks had adopted the use of DFM in combination with olive oil in antiquity is confirmed in the reports of ancient Greek writers. It is also depicted on ancient vases; a typical example is shown in a red cylix figure (Figure 1), with thematology inspired by the commission of DFM in the waist, back and arms of an athlete. Additionally, according to another representation, it is preserved in a red-crater (Figure 2). The preparation of the athletes before the commission of exercises at the Palaestra (sports facility) is depicted. On the left of the representation a trainee can be seen having his feet massaged. The athlete standing upright in the middle of the scene (Figure 2) spills oil from a vase into his left hand in order to spread it on to his body. These depictions, along with references from ancient authors, are irrefutable historical evidence that the use of DFM was carried out and widely accepted by the ancient Greek athletic world.

Ailianos claimed that rubbing with oil was first discovered by the Athenians: “καὶ τὸν ἀγωνα δίκτοις ομάστον ἡλείψαντο”.14 The person (aleiptes) who was charged with performing the necessary manoeuvres for oil massage needed to be aware of the strength and age of the trainee.15 The implementation of DFM with oil was important not merely for warming up but also to achieve the desired performance. After the end of the sporting event the athlete scraped his body with a strigil (stlengis), a curved tool. The strigils removed from the body surface area not merely the products of metabolic processes (sweat) but also the combination of oil, sweat and dust. This mixture was called “gloios” and it was collected in vases and sold for its presumed medical value.13 In addition, athletes used a sponge to wash themselves after the scraping was completed. After the scraping procedure, the aleiptes of the palaestra applied a massage to the athletes in order to appease the fatigued body.5,13

The post-exercise DFM combined with the spreading of oil was beneficial for reducing muscle fatigue. In particular, the friction increased the blood flow to the underlying tissue (at a local level) and helped to achieve more rapid removal of lactic acid from the tissues of the fatigued neuromuscular system of the athlete. In this way, ancient Greeks achieved better recovery of body acid-base balance and further restored the pH of arterial blood to normal levels (pH 7.35-7.45). The ancients knew through visual observation the beneficial results of using oil as a means of reducing muscle fatigue and faster recovery of the athletes. According to Lucian, olive oil had positive effects on athletes’ bodies: “Then we rub their bodies with olive oil and work it in so that they will have better tone.”10

Furthermore, according to Hippocrates, the post-exercise massage helped to alleviate muscle pain: “The rub with oil and water softens the body …”12 From this it can be inferred that Hippocrates and his contemporaries were aware of the analgesic properties of deep friction. This hypothesis was verified by modern research findings, according to which massage increases local blood flow, relaxes muscles and further mobilizes and opens scar tissue.16 In particular, the application of local friction increases the local temperature and contributes to better blood flow, owing to the induced dilatation and increased permeability of blood vessels.16 According to another synchronous study, massage has both a reflective and a mechanical action.17 It contributes to effective reduction of increased muscle tone and further increases venous return.17 In addition, it reduces the levels of creatine kinase and the number of circulating neutrophils, and delays the onset of muscle pain after eccentric exercise by disrupting the inflammatory response.16 However, DFM in conjunction with olive oil was used not only for therapeutic purposes in ancient Greece, but as a means for preventing or averting sports injuries. Because of the flexibility it conferred on the skin of the contestants, the oil not only allowed freedom of movement but also helped to prevent injuries. The skin, and therefore the body, became flexible through friction with oil. The slipperiness made the force applied less intense and prolonged than that achieved with non-oiled leather. It protected an athlete from painful and potentially injurious handling such as trapping of the neck (trachilisms).

During wrestling, the oiled body gave the athlete the opportunity to avoid dangerous handling by the opponent, such as entrapment of the waist “μεσοφέρδνη” or throat “τραχηλίζειν”, because the body was able to slide.18 The slipperiness acquired helped the body to reduce the intensity and duration of hazardous applied handling. By means of this reduction, in combination

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**Figure 2.** Red crater. Depicts the preparation of athletes in the arena before the commission of exercises. To the left, a slave is kneeling to massage the foot of an athlete. The athlete in the centre pours oil from an aryballos into his palm in order to rub his body. The athlete on the right turns the cloth carefully in order to be stripped and then exercise himself. Around 510 BC (the picture is from the book "Olympic History" edited by Stergios Fasoulakis Professor of History, University of Athens, Athens 2004, p. 45). West Berlin, Staatliche Museen.
with the increased capacity of the skin (through flexibility) to receive larger forces, oil helped to prevent sports injuries. Oil also had additional benefits. In particular, when it was rubbed on the human body, oil prevented full exposure to the negative effects of solar ultraviolet radiation. However, this (protection from the sun conferred by olive oil) has not been established scientifically and its confirmation will require further research before application in modern public health.

**RECENT STUDIES**

The beneficial results of using olive oil with DFM have been confirmed by recent studies. Steward and colleagues used DFM as a therapeutic modality for tendinitis, muscle strains, ligament sprains and capsulitis of the trapezio-first-metacarpal joint. Depending on the stage and site of the lesion, treatment sessions may be as brief as five minutes or as long as 20 minutes. Many therapists find DFM very effective, but they stated that treatment is too fatiguing to administer. Brosseau and colleagues recommended deep transverse friction massage (DTFM) as one of several physiotherapy interventions for managing tendonitis pain. Mayer and colleagues found that pain (in 31 male runners with unilateral, untreated Achilles tendonopathy who completed four weeks of either physiotherapy, 10 treatments, deep-friction, pulsed ultrasound, ice or sensory motor training) was reduced to <50% of the baseline.

Cherkin and colleagues conducted a systematic review of the existing literature and randomized controlled trials evaluating massage therapy, acupuncture and spinal manipulation. The purpose of their survey was to provide a rigorous and balanced summary regarding the effectiveness, safety and costs of the three treatments for lower back pain. They concluded that massage was safe and effective for persistent lower back pain and that it could reduce the costs of care after the course of treatment. According to Boisauvert and colleagues, physiotherapy (pulsed ultrasound, DFM and exercise programme) is a preferred option in the long term. Moyer and colleagues revealed that massage therapy can lead to pain relief, reduction of anxiety and depression, temporarily reduced blood pressure, heart rate and reduced anxiety state. A study carried out by Kuriyama and colleagues suggests that aromatherapy massage could be beneficial for diseases that require augmentation of CD8+ lymphocytes. Aromatherapy massage increases peripheral blood lymphocytes, possibly because of an increase in the numbers of CD8+ and CD16+ lymphocytes. Aromatherapy is a valuable relaxation technique that reduces anxiety and stress, and is beneficial to the immune system.

Ostermann and colleagues reported that repeated rhythmic embrocation with oil could have a positive impact on mood and pain perception, and may contribute to the ability to cope with chronic lower back pain. According to Coff and colleagues, patients suffering from lateral epicondylitis demonstrated a significantly reduced pain and improved functional ability following soft tissue massage, stretching, ultrasound and exercise. The bulk of evidence confirms the positive effects of using massage and/or olive oil for treating various musculoskeletal injuries.

**CONCLUSION**

Oil and its beneficial effects were well known in the ancient world. By using olive oil, the Greeks succeeded in increasing skin elasticity and the blood supply to underlying muscles. In addition, post-exercise massage combined with the oil rubbing resulted in a more rapid recovery by the athlete, as the blood flow increased and the major metabolic product (lactic acid) was removed rapidly from the dilated blood vessels. Furthermore, oil rubbing lubricated the athletes’ bodies and made them more flexible. This resulted in its use being adopted not only as a means of treatment, but also for the prevention of sports injuries.

The beneficial results of deep friction massage with oil require further research by scientists specializing in sports medicine and biomedicine. It is anticipated that this article will stimulate further trials, with use of appropriate methods and adequate sample sizes, to reveal the benefits of olive oil and its potential applications in modern medicine, coaching and physiotherapy. Further research is required to elucidate the positive effects of DFM massage in combination with olive oil and the mechanisms underlying them.

**REFERENCES**


