Introduction. Achilles tendonitis has become one of the most common athletic injuries and is reported to be the most common injury in sporting activities.[1,2] Furthermore, tendonitis of the Achilles is the most commonly reported form of tendonitis and accounts for between 10 and 15% of all running injuries.[3,4] The condition typically affects the mature male athlete who engages in a high degree of running and jumping activities.[4] Actually, any person who runs or participates in a sport that involves running, risks incurring Achilles tendonitis.[5] It is frequently found in runners, ballet dancers, basketball players and those involved in racket and jumping sports. Clement, et al followed 650 runners (60% males) for two years, during which time 109 (16.8%) developed Achilles tendonitis of which 78% were males.[6]

The Achilles tendon is the largest tendon in the body and it receives fibres from the soleus and gastrocnemius muscles, the so-called triceps surae. This musculo-tendinous complex thus crosses the knee, talocrural and subtalar joints, with the Achilles tendon crossing both the ankle and subtalar joints.[5] It was therefore hypothesised that any dysfunctions of these latter joints could detrimentally affect the function of, and perhaps the circulation in the tendon, and thus chiropractic manipulation of these dysfunctions could well facilitate the recovery of Achilles tendonitis.

Chronic Achilles tendon injuries treated by using eccentric contraction usually resolve in 6-12 weeks.[7] For those patients seeking treatment after many months of symptoms, recovery can sometimes take as long as two years. The natural history is estimated to being about 12 weeks.[7]

In terms of specific studies in the treatment of Achilles tendonitis, Astrom and Westlin tested the efficacy of piroxicam in a double-blinded placebo-controlled trial in 70 non-rheumatic adults with painful Achilles tendinopathy.[8] No differences were seen between the two groups at any time during the study. Morag, et al reported that patients with Achilles tendonitis, who were treated by

endoscopic intervention, were able to resume their daily and sporting activities after 2-3 months.[9] Lowdon, et al, in a double-blind trial, showed that ultra-sound, exercises and a visco-elastic heel pad were no more beneficial than ultra-sound and exercises alone.[10] Shrier, et al reported that when looking only at the methodologically rigorous studies, corticosteroids showed no benefit over placebo in the treatment of Achilles tendonitis.[11]. Baquie reported that taping can provide proprioceptive awareness in Achilles tendonitis.[12] In a review of the literature, Cohen and Balcom emphasised that the treatment for Achilles tendonitis and tendonosis is not an overnight fix – symptoms sometimes persisting for months before resolution.[13] In a review of the literature, Kvist found that surgery was required for about 25% of athletes with Achilles tendon overuse injuries, and the frequency increased with age of the patient and the duration of symptoms.[14] Of those requiring surgery, 20% required a second operation because of incomplete healing, all at immense cost. Results of such surgical intervention have been, at best, mixed.[15]

The paucity of studies of the conservative management of this condition, and the expense and potential long-term disability of surgery, makes it clear that the identification of a more cost-effective, conservative treatment for this condition be sought.

Methods

This study received the approval of the Research Committee of the (name of institution), ensuring that the research was conducted in accordance with the Helsinki Declaration of 1975. Advertisements were placed for subjects with sub-acute and chronic Achilles tendonitis. For the purposes of this study, sub-acute was defined as having had the problem from 2 days to 2 weeks, and chronic was defined as longer than 2 weeks. Fifty-one subjects were accepted into the study, forty of them completing it. Inclusion criteria required that subjects be between the ages of 15 and 60, and be diagnosed as having sub-acute or chronic Achilles

tendonitis. A diagnosis of Achilles tendonitis was made if the first two of the following criteria were present and at least two of the other criteria:

- pain at the inferior aspect of the posterior calf, the Achilles tendon and the heel;
- tenderness to palpation along the tendon from its insertion into the calcaneus and the 5-6 centimetres proximal thereto;
- generalized swelling in the lower calf and Achilles tendon;
- increased warmth over the tendon;
- reduced passive or active dorsiflexion of the ankle with pain;
- stiffness within the lower calf and Achilles tendon;
- crepitus along the tendon;

Exclusion criteria were:

- subjects requiring x-rays for suspected pathologies;
- subjects on anti-coagulant therapy or those with bleeding disorders;
- the Achilles tendonitis being associated with systemic disorders or other pathologies;
- the taking of any medication, or receiving any other form of treatment for the tendonitis;
- if they re-injured their Achilles tendons during the course of the trial;
- if they embarked on any stretching programme of the Achilles during the course of the trial;
- if they presented with a positive Thompson's test;
- they had instability of the foot and/or ankle joints.

After having had the nature of the study fully explained to them, and having had all their questions answered, persons agreeing to participate in the study then completed a written, informed consent form. Participants in the research understood that they would in no way be identified, that all data would appear as aggregates only.

Each subject was then allocated a Case Number so that no form of subject identification appeared on the data summary sheets. Subjects were randomly allocated to one of two groups, Group 1 receiving manipulation of any joint dysfunctions found in the foot, subtalar or mortise joints, as described by Bergman, whilst Group 2 received de-tuned ultra-sound.[16] Subjects in both groups received 6 interventions over a one-month period, evenly spaced apart.

The two groups were compared in terms of:

- the extent of their dorsiflexion, as assessed using a J Tech Autogon 11 goniometer. The method used was that described by Jonson and Gross;[17]
- quality of pain (McGill Short-form Pain Questionnaire);
- severity of pain (Numerical Pain Rating Scale-101);
- pressure pain threshold assessed at the site of worst pain (Wagner Instruments, Greenwich, CT, USA;
- motion palpation findings.

The principal researcher was experienced in the use of the goniometer and algometer, and he conducted all assessment and treatment procedures of the subjects.

The subjective and objective measurements were taken at the first, second, third and sixth visits so as to identify initial changes, as well as those at the end of the study.

All resources and funding for this study were supplied by the (name of institution)

Results.

The data in this study was analysed using Statistica 6.0.

A total of 51 persons were admitted to the study with 40 completing it. Reasons for non-completion were:

Lack of transport to the clinic …….	3
Moved to another city …….	2
Recovered before the end of treatment ……..	1
Did not have time to continue with treatment …….	4
Was excluded because of other concurrent treatment …….	1
Total	11 (22%)

The age-distribution of the two groups was similar, with the exception of the two oldest groups (Table 1).

Table 1. Age distribution.

There was a preponderance of males to females of almost two to one between the two groups (Table 2).

Table 2. Gender distribution.

The following table reflects the distribution of chronicity of the condition amongst the subjects.

Table 3. Chronicity of tendonitis.

In effect, therefore, this study only looked at the effect of manipulation on chronic Achilles tendonitis.

In terms of any of the outcomes assessed, there were no statistically significant differences between the two groups at the first consultation (Table 4).

Table 4. Comparison of Groups at Consultation 1.

By the second consultation, the algometer readings were already showing a statistically significant difference (Table 5).

Table 5. Comparison of Groups at Consultation 2.

However, by the third consultations, all outcomes were statistically significantly improved (Table 6).

Table 6. Comparison of Groups at Consultation 3.

By the final consultation, this trend had continued, as reflected in Table 7.

Table 7. Comparison of Groups at Consultation 6.

It was interesting to note that in terms of intra- group comparisons, the treatment group showed significant changes by as soon as the second consultation, with the trend continuing until the sixth visit. However, the placebo group only showed significant changes starting at the 6^{th} consultation (Table 8).

Table 8. Intra-group levels of significance (p-values) at 2^{nd}, 3^{rd} and 6^{th} consultations.

Table 9 represents the frequency of the different joint dysfunctions identified during the course of the study. Some subjects had more than one joint dysfunction, hence the total being more than 100%.

Table 9. Location of joint dysfunctions and type of manipulation used.

Discussion.

With only one subject classified as sub-acute, one could reasonably conclude that the study applied only to chronic states of Achilles tendonitis.

As support for the rationale of using manipulation as a possible useful intervention in the management of Achilles tendonitis, it was noted that the myotendinous junction of the triceps surae and the Achilles tendon corresponds to the area where patients with Achilles tendonitis frequently complain of having pain[18] and it is commonly the site of strains and delayed muscle soreness.[19] According to the last mentioned authors, muscles crossing two joints are at particular risk of strain during eccentric contraction, and they believe that it is probably significant that the tightness of such muscles limits joint movement. Poor flexibility within the gastrocnemius and soleus unit, estimated by the range of ankle plantar and dorsiflexion motion, was found to be a common aetiological factor for the development of Achilles tendonitis, as poor flexibility of these muscles increases the strain on the tendon. Values less than 12 degrees dorsiflexion and 25 degrees plantarflexion are considered inadequate.[6] According to Leach, et al a common finding in patients with Achilles tendonitis is a loss of passive ankle dorsiflexion.[20] Humble and Nugent emphasize the causative role of inflexibility and the tensile stresses to which the tendon and surrounding tissues are exposed.[21] It was hypothesised that this poor flexibility is due, at least in part, to joint dysfunctions and not entirely to tight muscles. Pellow (unpublished Masters Dissertation, … (name of institution) …1999) showed in patients suffering from sub-acute and chronic Grades I and II ankle sprains, that following a mortise separation manipulation, the ankle dorsiflexion range of motion increased significantly. Such evidence may lend support to the role of joint manipulation in the management of Achilles tendonitis. The relationship of tendon length to injury can be described in terms of the muscle tendon units resting length. When the resting length is increased, decreased strain (deformation) takes place during a particular range of movement. A shortened Achilles tendon is placed under greater strain than a longer one. Also, lack of adequate dorsiflexion could cause unwanted compensation in the form of excessive pronation, further aggravating the problem.[22] Arguing from the observation that joint manipulation appears to result in a reduction of associated muscle tone, it is further hypothesised that manipulation of the ankle and subtalar

joints might result in greater relaxation of the triceps crurae, which in a case of Achilles tendonitis, might facilitate its recovery.[23] Overall, then, it was hypothesised that an increase in ankle dorsiflexion should indicate an improvement in the tendonitis. A highly significant difference in dorsiflexion between Groups 1 and 2 was noted by as early as the 2nd consultation (following one manipulation) and was maintained until the end of the study. Whether this increased range of motion was due to increased joint mobility, reduced muscle tone or a combination of the two, the study did not address. There was no follow-up of subjects following the study.

The plantaris tendon runs between the gastrocnemius and soleus muscles, but has its own insertion separate from the Achilles tendon, namely, just medial to it, and in some cases it inserts into the plantar fascia.[24,25] Furthermore, Snow, et al. reported that there is some continuity between fibres of the Achilles tendon and the plantar fascia.[26] It was for this reason that it was decided in this study to manipulate all foot and ankle joint dysfunctions, it being hypothesised that such could have a loosening effect on the plantar fascia, which in turn could have an effect on the Achilles tendon and plantaris muscle and tendon. This approach was taken, as opposed to that recommended by Clement, et al, who suggested that only the subtalar and the mortise joints be mobilized for this condition.[6]

As the tendon descends from its muscular attachment, it may spiral up to 90 degrees laterally, so that the medial aspect becomes the posterior aspect distally. The significance of the rotation is that a region of concentrated stress may be produced where the tendons of the soleus and the gastrocnemius meet. This is most prominent at 2 to 5 centimetres proximal to the insertion into the calcaneus and corresponds to the region of the tendon with the poorest vascular supply.[14] Clement, et al, and Curwin and Stanish argue that the reduced vascularity in this area may be an important etiological factor in the development of Achilles tendonitis.[6,1] If true, it might be that ankle and subtalar joint dysfunctions add to such stress.

This study seems to be the first published one on the clinical usefulness of manipulation in the management of Achilles tendonitis. In comparison with the natural history of the disorder, as well as with existing conservative care for this disorder, manipulation seems a highly effective intervention.

With by far the majority of joint dysfunctions having been located in the mortise and sub-talar joints (Table 9), such certainly gives credence to the recommendations of Clement, et al[6], who stated that one should focus on restoring motion to these joints in the treatment of Achilles tendonitis. The findings of this study are all the more significant given the cost and possible sequela of the "final solution" for this problem, namely surgery.

Conclusions.

This study set out to determine the efficacy of manipulation in the management of sub-acute and chronic Achilles tendonitis. The evidence from this study would indicate that manipulation of dysfunctional joints of the foot and ankle, and particularly of the mortise and sub-talar joints, plays a significant role in the successful management of this condition. The results are particularly significant in light of the statement by Curwin that the natural history of this condition is about 12 weeks, with recovery taking up to 2 years in some instances, even with treatment.[7]

Limitations and Recommendations.

In this study, there was no stratification of the subjects in terms of severity of injury (Grades I and II) or whether or not the subjects participated in any sporting activity. Such stratification could have produced more homogeneous groups. Further, the use of an objective observer would probably have produced greater reliability in terms of the objective findings. Follow-up studies to determine the medium and longer term effects of manipulation as an intervention would have been useful.

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