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The Efficacy of Adjusting the Ankle in the Treatment of Subacute and Chronic Grade I and Grade II Ankle Inversion Sprains

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ABSTRACT

Objective: The purpose of this study was to determine the efficacy of adjusting the ankle in the treatment of subacute and chronic grade I and grade II ankle inversion sprains.

Design: A single-blind, comparative, controlled pilot study.

Setting: Technikon Natal Chiropractic Day Clinic.

Participants: Thirty patients with subacute and chronic grade I and grade II ankle inversion sprains. Patients were recruited from the public; they responded to advertisements placed in newspapers and on notice boards around the campus and local sports clubs.

Intervention: Each of the 15 patients in the treatment group received the ankle mortise separation adjustment. Each of the 15 patients in the placebo group received 5 minutes of detuned ultrasound treatment. Each participant received a maximum of 8 treatment sessions spread over a period of 4 weeks.

Main Outcome Measure: Patients were evaluated at the first treatment, at the final treatment, and at a 1-month follow-up consultation. Subjective scores were obtained by means of the short-form McGill Pain Questionnaire and the Numerical Pain Rating Scale 101. Objective measurements were obtained from goniometer readings measuring ankle dorsiflexion range of motion and algometer readings measuring pain threshold over the ankle lateral ligaments. A functional evaluation of ankle function was also used.

Results: Although both groups showed improvement, statistically significant differences in favor of the adjustment group were noted with respect to reduction in pain, increased ankle range of motion, and ankle function.

Conclusions: This study appears to indicate that the mortise separation adjustment may be superior to detuned ultrasound therapy in the management of subacute and chronic grade I and grade II inversion ankle sprains. (J Manipulative Physiol Ther 2001;24:17-24)

Key Indexing Terms: Ankle; Inversion Sprain; Chiropractic

INTRODUCTION

Ankle sprains are one of the most prevalent acute injuries treated in emergency departments and physicians' offices.[1] Ankle injuries account for up to 10% of sports-related injuries. The ankle sprain is probably the single most common injury in sports.[2] Eighty-five percent of ankle injuries are ankle sprains.[3] At least 95% of isolated ankle sprains involve the lateral ligaments.[4] Ankle injuries account for 20% to 25% of time lost because of injury in running and jumping sports.[5]

Most of the continuing symptoms following a sprained ankle, such as pain, a feeling of instability, crepitus, weakness, and stiffness are believed to be directly related to untreated ligament damage. The main causes of these continuing symptoms are functional instability, joint stiffness due to loss of joint motion, scar tissue, and incomplete or absent rehabilitation.[4]

A common sequela of ankle sprains is the loss of ankle dorsiflexion, as a result of which the talar dome cannot lock fully into the ankle mortise; this leads to a loss of bony stability during locomotion.[6] For minimal normal locomotion to occur, the ankle should be able to actively dorsiflex 10 degrees and plantarflex between 20 and 25 degrees.[7] Restricted ankle dorsiflexion range confers an increased risk of lower limb injuries, especially ankle sprains.[8]

Adjustive therapy is a procedure that may induce quick distraction and break the intraarticular adhesions. Early intervention for soft tissue injury by means of manual therapy will promote better healing, decrease pain and inflammation, prevent further injury, and promote flexibility.[9]

In a randomized, controlled clinical trial involving a single talocrural manipulation of high velocity and low amplitude in a group of 20 asymptomatic subjects, there were no statistically significant changes in ankle dorsiflexion range in either the experimental group or the control group. However, it was suggested that a similar trial be performed in a symptomatic population, inasmuch as symptomatic patients have often reported a "feeling" of reduced stiffness and subjective improvement in function-

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Table 1. *Grading of ankle sprains*

Grade/severity	Signs and symptoms
Grade I (mild):	
stable	No hemorrhage
	Minimal swelling
	Point tenderness
	Negative anterior drawer sign
	No varus laxity
Grade II (moderate):	
stable	Some hemorrhage
	Localized swelling
	Less defined margins of Achilles tendon
	Anterior drawer sign may be positive
	No varus laxity
Grade III (severe):	
2-ligament, unstable	Diffuse swelling on both sides of Achilles tendon
	Early hemorrhage
	Tenderness may occur medially and laterally
	Positive anterior drawer sign
	Positive varus laxity

Adapted from: Reid DC. Sports injury assessment and rehabilitation. New York: Churchill-Livingstone, Inc; 1992. p. 217-50.

al abilities, such as walking up stairs, after manipulation of the ankle joint.[10]

Manipulative therapy may play a role in the management of conditions in which clinical joint instability is present, not merely in mechanical disorders with associated joint hypomobility. The chiropractic profession emphasizes specific short-lever procedures, speculating that these are more precise in correcting local joint dysfunction without inducing stress or possible injury to adjacent joints. This may play a significant role in circumstances of adjacent joint instability.[9]

The mortise separation adjustment is less likely to compromise the integrity of the lateral ligament complex of the already injured ankle and is indicated in the treatment of subacute inversion ankle sprains. This chiropractic technique involves setting the ankle up in dorsiflexion and eversion before a long axis thrust is applied.[11]

The main goals when an ankle sprain is being treated are to achieve static and dynamic stability, gain normal ankle range of motion, and achieve optimal strength of the peroneal muscles, dorsiflexors, plantarflexors, and inverters of the ankle.[5]

Most ankle injuries that involve the lateral ligaments of the ankle can be managed favorably in the primary care setting. It has been advocated that early intervention with conservative treatment, such as compression, mobilization, exercise, and contrast baths, is important to prevent chronic symptoms.[12]

This study sought to determine whether adjustment of the ankle in a symptomatic population would be an efficacious treatment in the management of subacute and chronic grade I and grade II inversion ankle sprains in terms of both subjective and objective clinical findings.

MATERIALS AND METHODS

This study was conducted at and funded by Technikon Natal. Patients were selected through use of convenience sampling. Advertisements were used to recruit potential patients. These advertisements were placed on notice boards and in local newspapers. Efforts were also made to notify people of the research by word of mouth.

Table 2. *Single vs recurrent ankle sprains encountered in sample of 30*

	Group 1	Group 2	Group 3
Single	5	4	30
Recurrent	10	11	70

Patients presenting to the Chiropractic Day Clinic with histories of ankle sprains and resulting residual ankle symptoms were considered potential candidates for the study. The researcher performed a brief clinical examination, which included the elicitation of details regarding the patient's "ankle" history, to determine the patient's suitability for the study. A more detailed foot examination, medical history-taking, and physical examination were conducted at a later stage.

Thirty subjects were needed to complete the proposed trial. To accommodate the possibility of noncompliant subjects and/or subject attrition, 36 subjects were initially included in the study. Five of the 36 patients were noncompliant with respect to the terms of the study, and the data obtained from these patients were therefore omitted from the study. One of the 36 patients reinjured his ankle and was excluded from the study.

Inclusion Criteria

The criteria for inclusion were as follows:

1. The patient was required to be 15 to 50 years of age.
2. The patient was required to give informed consent before any treatment could be administered. Minors had to receive permission from their parents/guardians to participate in the study.
3. No restrictions were placed with respect to race or gender, coexisting conditions, patient occupation, income bracket, or area of residence.
4. All patients were required to have been diagnosed with subacute and chronic grade I and grade II ankle inversion sprains according to the criteria set out to determine ankle inversion sprain severity[4] (Table 1). The diagnosis was based on the history of the most recent sprain. For the purposes of this study, *subacute* and *chronic* were defined (according to Reid's[4] classification system) as more than 48 hours after the initial injury and more than 5 days after the initial injury, respectively.

Exclusion Criteria

The criteria for exclusion were as follows:

1. Patients who experienced reinjury were excluded from the study.
2. Patients taking any medications or undergoing any other modes of treatment for their ankle injury were excluded. Patients were instructed not to initiate any other forms of treatment while taking part in the study.

Table 3. *Modes of treatment encountered within sample of 30 before entering research project*

Treatment	Group 1	Group 2
None	1	1
Cryotherapy	7	7
Compression	3	9
Taping	7	3
Bracing	2	3
NSAIDs—topical	4	9
NSAIDs—oral	6	8
Arnica—topical	1	2
Manual therapy	7	3
Rest	1	2
Ultrasound	1	1
Interferential current	1	0
Transverse friction	2	0
Immobilization	1	1
Crutches	1	2
Ankle exercises	0	1

3. Patients showing signs of gross mechanical ankle instability (grade III ankle sprain) and syndesmosis injury were excluded from the study.
4. Patients who demonstrated any relative or absolute contraindications to manipulative therapy[13] on the basis of case history, physical examination, foot and ankle examination, and radiography (if warranted) were excluded.

Patient Examination

Special note was made of patients who experienced recurrent ankle sprains and of the types of treatment, if any, that had been received (Tables 2 and 3). After a thorough clinical examination, it was decided by both the researcher and the clinician on duty whether or not the patient would be sent for radiographs of the ankle joint. Radiographs were to be used to confirm any suspected pathosis that might be a contraindication to adjustments. (Radiographs are usually not necessary as long as the patient does not exhibit tenderness over the posterior distal portion of either the medial or lateral malleolus and as long as the patient is able to bear weight immediately after the injury.[12])

These prerequisites were initially based on the decision rules for the use of radiography in acute ankle injury.[14] On the basis of these rules, no patients were sent for radiographs. Three of the patients presented to the Chiropractic Day Clinic with their foot and ankle radiographs, none of which showed any fracture or other underlying pathosis at the time of injury.

Eligible patients were given a detailed description of the intended treatment procedure and were informed about the possibility that they would be receiving placebo treatments as well as about their right to withdraw from the trial at any time.

Patient Allocation

For the allocation of each patient to one of the groups, the examiner drew one of thirty pieces of paper from an envelope. Fifteen of these pieces of paper were marked "1," which represented the adjustment or experimental group; the other 15 pieces of paper were marked "2," which represented the placebo or control group.

Table 4. *Grades of ankle sprain encountered in sample of 30*

	Group 1	Group 2	Total percent
Grade I	6	6	40
Grade II	9	9	60

Table 5. *Chronicity of sprains encountered within sample of 30*

	Group 1	Group 2	Total percent
Subacute	1	0	3
Chronic	14	15	97

Interventions

The patients were treated according to their group allocations. The patients received treatment until they either were symptom free or had received a maximum of 8 treatments over a period of 4 weeks. A follow-up consultation for reassessment took place 1 month after the last treatment.

The experimental group received the mortise separation adjustment. This adjustment was chosen because it is less likely to compromise the integrity of the lateral ligament complex of the already injured ankle and because it is indicated in the treatment of subacute inversion ankle sprains. The reasoning behind this choice is that the ankle is set up in dorsiflexion and eversion before the thrust is applied.[11]

The mortise separation is performed with the patient lying supine. The doctor kneels at the foot of the table and grasps either the lateral or medial border of the patient's foot with his or her thumb on the sole of the foot and his or her fingers on the dorsum of the foot. The doctor's other hand grasps the opposite border of the foot and holds the foot in a similar manner. The doctor then dorsiflexes the ankle, internally rotates the patient's entire leg, everts the foot, and finally thrusts away from the patient, the line of drive being parallel to the floor.[11]

The adjustive contacts are often placed close to the joint being treated, and the thrust is delivered in the limits of anatomic joint integrity. Adjustments are usually associated with an audible articular crack, but the presence or absence of joint cracking should not be the test for determining whether or not an adjustment has been successful.[9]

Each patient in the control group was given a course of treatments with a detuned ultrasound machine for a period of 5 minutes per treatment session. This method of intervention was used to eliminate any possible direct mechanical changes to the ankle being treated.

Research Design

This was a single-blind, comparative, controlled pilot study.

Measurement Tools Used for Data Collection and Analysis

All subjective and objective data used for statistical analysis were collected at the first consultation, the final treatment, and the 1-month follow-up consultation. All measurements were measured and recorded by the researcher.

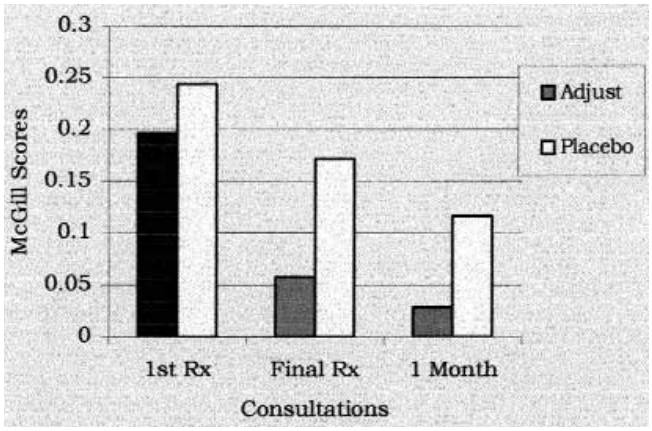

Fig 1. *Mean values obtained from short-form McGill Pain Questionnaire.*

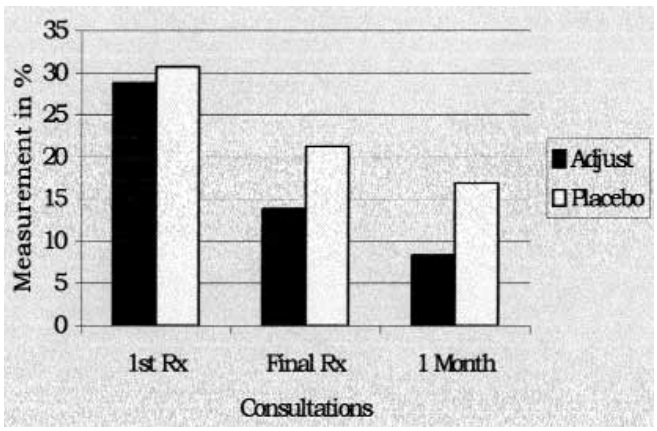

Fig 2. *Mean values obtained from Numeric Pain Rating Scale 101.*

Table 6. *Age distribution within sample of 30*

Age (y)	Group 1	Group 2	Total percent
15-24	10	8	60
25-34	5	4	30
35-44	0	2	7
45-50	0	1	3

Mean ages (y): group 1, 23.7; group 2, 26.1; overall, 24.9.

Table 7. *Gender distribution within sample of 30*

Gender	Group 1	Group 2	Total percent
Male	6	13	63
Female	9	2	37

All questionnaires were completed by the patients under the supervision of the researcher.

Objective findings included ankle dorsiflexion range of motion and localized lateral ankle ligament tenderness measurements.

Measurement of ankle dorsiflexion with a goniometer has demonstrated high intraexaminer reliability. This was achieved as follows: The subject is placed in a prone position with the knee extended and then instructed to actively dorsiflex the foot while the examiner moves the foot passively into dorsiflexion. One arm of the goniometer is aligned with the fifth metatarsal and the other arm with the head of the fibula.[15] Ankle dorsiflexion is measured through use of this method because it is practical, reliable, and inexpensive. Zero degrees is taken as the point at which the foot is perpendicular to the leg—ie, the point at which the ankle was between plantarflexion and dorsiflexion. The goniometer used in the study was a Baseline (Fabrication Enterprise, Inc, Irvington, NY).

Use of an algometer served as a means of measuring pain threshold (kg/cm^2) over the anterior talofibular ligament. Algometry has been found useful in clinical trials as a means of objectively measuring the effects of spinal manipulation on the overlying soft tissue structures in terms of changes in pain thresholds.[16-17] The algometer used in this study was a force dial manufactured by Wagner Instruments (Greenwich, Conn).

Subjective findings were measured through use of (1) the short-form McGill Pain Questionnaire,[18] the score being expressed as a ratio, and (2) the Numerical Pain Rating Scale 101,[19] the score being expressed as a percentage.

A functional evaluation scoring scale for ankle injuries was also used. This scoring scale has been shown to demonstrate excellent reproducibility and can significantly differentiate between healthy controls and symptomatic patients in terms of subjective, objective, and functional evaluation of ankle injuries.[20]

Data Analysis

The data collected by the researcher were statistically analyzed through use of a 95% confidence level. Because of the small sample size (15 subjects per group), the nonparametric Mann-Whitney *U* test and the Wilcoxon signed rank test were used for comparing intergroup and intragroup data, respectively. This was conducted at an $\alpha = .05$ level of significance. In addition, power analysis was used to detect the possibility of committing errors of type II (accepting a false null hypothesis) when analysis was performed on the data.[21] These data, as well as the descriptive statistics, are presented in tables and bar charts.

RESULTS

The results are presented in Tables 4 through 12. The results include demographic data, analyzed objective and subjective data, and bar charts (Figs 1-5). Statistically significant findings are printed in bold type.

DISCUSSION

General Discussion of the Study

Subjective measurements. Because this study included subjective measurements (ie, the short-form McGill Questionnaire and the Numerical Pain Rating Scale 101), there

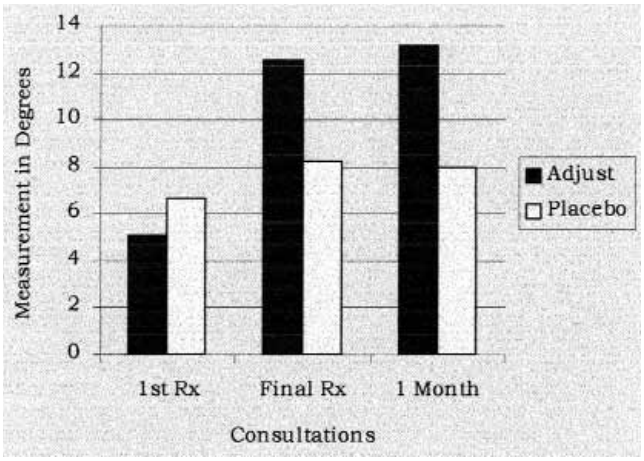

Fig 3. *Mean values obtained from goniometer readings measuring ankle dorsiflexion range of motion.*

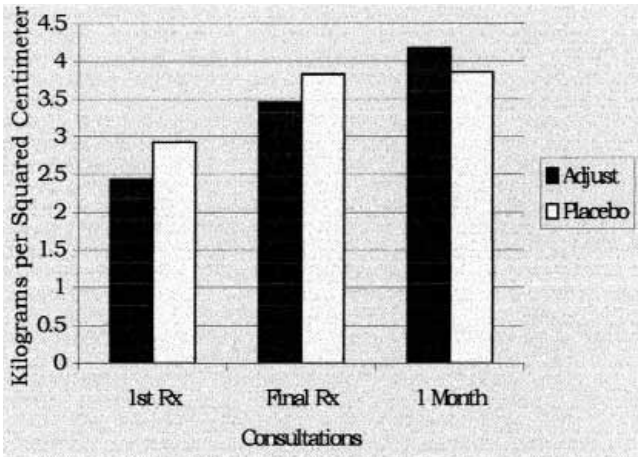

Fig 4. *Mean values obtained from algometer readings.*

Table 8. *Activity leading to injury in sample of 30*

Activity	Group 1	Group 2
Tennis	1	1
Running	0	2
Basketball	0	2
Work-related	2	1
Jet skiing	0	1
Squash	0	1
Waterskiing	0	1
Rugby	3	3
Skateboarding	1	1
Volleyball	0	1
Horseback riding	1	1
Aerobics	1	0
Karate	2	0
Softball	1	0
Soccer	1	0
Other	2	1

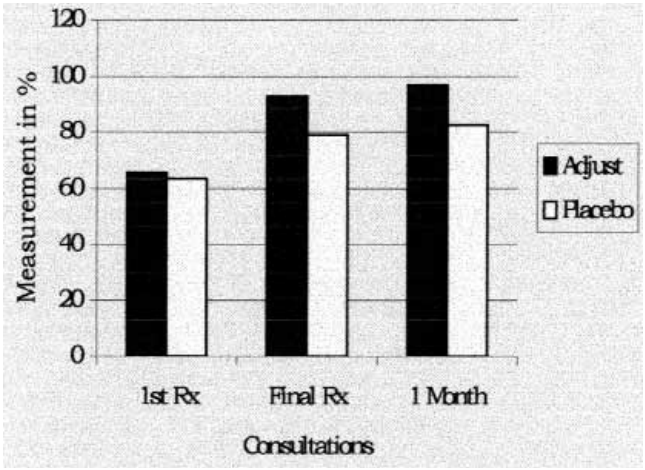

Fig 5. *Mean values obtained from functional evaluation scores.*

was a potential for patient bias: he or she might have attempted to please the examiner by recording a lower score, indicating an improvement that was not actually there.

Objective measurements. Two areas of potential error in using the universal goniometer and algometer are examiner error and instrument error.

Blinding. Researcher bias could have been controlled for if an independent blind observer had selected patients, recorded all the measurements, and aided the patients in the process of completing the questionnaires.[22]

Patient history and demographics. In both groups, the patient histories were similar in terms of grade, chronicity, and the nature of the ankle sprains incurred (ie, single or recurrent). The symptomatic time period for both groups ranged from 3 days to 2 years (Tables 2, 4, and 5).

Most of the patients in the study were less than 24 years of age (mean, 24.9 years) and male (63%; Tables 6 and 7). The two groups were not similar with respect to sex distribution; group 1 included more females than males and group 2 included more males than females (Table 7).

Operational definitions. There appears to be no standard agreement on what is actually meant by the terms *subacute* and *chronic*. Therefore, for the purposes of this study, definitions of these 2 terms were taken from Reid[4]: *subacute* was defined as more than 48 hours after the initial injury, and *chronic* was defined as more than 5 days after the initial injury.

Sample size and patient allocation. A larger sample size should be selected through use of parametric statistical analysis to improve the validity of the research. Parametric statistical analysis should be used with the chance of a type II error limited to a set level.

Stratified randomization procedures should be used, age, sex, race, location, and occupation being taken into account. Subjects should be matched on the basis of sex, similar age, and similar history.[23] These factors could aid in making the sample more linear in distribution and thus producing more valid trial conclusions. Patients should be stratified according to severity of injury (grade I or grade II), nature of the sprain (recurrent or single), and participation or nonparticipation in sports activities to prevent the chance occurrence of an unequal distribution between treatment groups with regard to these prognostic factors.

Homogeneity. Except with respect to gender distribution, overall homogeneity in the study was good (Table 7). It is

Table 9. *Results obtained from Mann-Whitney unpaired tests between groups 1 (adjustment) and 2 (placebo)*

		Standard deviation		Standard error		Mean			
Group		1	2	1	2	1	2	*P* value*	Power
Treatment 1	McGill	0.1040	0.1392	0.02686	0.03593	0.1960	0.2433	.418	.1725
	NRS 101	16.5442	12.7907	4.2717	3.3025	28.7333	30.7333	.723	.0634
	Goniometer	4.8619	5.2863	1.2553	1.3649	5.0667	6.6333	.603	.1230
	Algometer	0.8432	0.8498	0.2177	0.2194	2.4333	2.9267	.114	.3255
	Functional	22.5093	24.9046	5.8119	6.4303	65.6667	63.3333	.851	.0570
Final treatment	McGill	0.09817	0.1627	0.02535	0.04200	0.05667	0.1713	**.005**	1.000
	NRS 101	15.8640	19.3038	4.0961	4.9842	13.8333	21.2667	.133	.1906
	Goniometer	5.8048	4.9203	1.4988	1.2704	12.5333	8.2667	.050	.5488
	Algometer	1.1300	0.9574	0.2918	0.2472	3.4533	3.8333	.350	.1523
	Functional	4.9522	16.6046	1.2786	4.2873	92.6667	79.0000	**.001**	.8387
One-month follow-up	McGill	0.05097	0.1223	0.01316	0.03159	0.02867	0.1160	**.004**	.7263
	NRS 101	12.8058	15.6267	3.3064	4.0348	8.3333	16.8667	.040	.3419
	Goniometer	3.3848	3.9279	0.8740	1.0142	13.200	80.00	**.001**	.9612
	Algometer	1.4093	1.1482	0.3639	0.2965	4.1800	3.8600	.395	.0964
	Functional	3.6187	12.5167	0.9344	3.2318	96.6667	82.3333	**.000**	.9824

*Statistically significant results appear in bold type.

Table 10. *Results obtained from Wilcoxon signed rank tests within adjustment group*

		Standard deviation		Standard error		Mean			
Group		1	2	1	2	1	2	*P* value*	Power
Treatment 1 and	McGill	0.1040	0.09817	0.02686	0.02535	0.1960	0.05667	**.001**	.9560
final treatment	NRS 101	16.5442	15.8640	4.2717	4.0961	28.7333	13.8333	**.001**	.6792
	Goniometer	4.8619	5.8048	1.2553	1.4988	5.0667	12.5333	**.002**	.9565
	Algometer	0.8432	1.1300	0.2177	0.2918	2.4333	3.4533	**.013**	.7715
	Functional	22.5093	4.9522	5.8119	1.2786	65.6667	92.6667	**.001**	.9905
Treatment 1 and	McGill	0.1040	0.05097	0.2535	0.01316	0.1960	0.02867	**.001**	.9995
1-month follow-up	NRS 101	16.5442	12.8058	4.0961	3.3064	28.7333	8.3333	**.002**	.9526
	Goniometer	4.8619	3.3848	1.4988	0.8740	5.0667	13.200	**.001**	.9986
	Algometer	0.8432	1.4093	0.2918	0.3639	2.4333	4.1800	**.002**	.9768
	Functional	22.5093	3.6187	1.2786	0.9344	65.6667	96.6667	**.001**	.9984
Final treatment and	McGill	0.09817	0.05097	0.02535	0.01316	0.05667	0.02867	**.017**	.1453
1-month follow-up	NRS 101	15.8640	12.8058	4.0961	3.3064	13.8333	8.3333	.113	.1643
	Goniometer	5.8048	3.3848	1.4988	0.8740	12.5333	13.200	.505	.00644
	Algometer	1.1300	1.4093	0.2918	0.3639	3.4533	4.1800	**.009**	.3133
	Functional	4.9522	3.6187	1.2786	0.9344	92.6667	96.6667	**.010**	.6810

*Statistically significant results appear in bold type.

recommended that future studies involve only one grade of sprain with a more specific period of chronicity and with selection based on the nature of the sprain (single incidence or a chronically recurring).

Statistical Limitations. The sample was too small to accommodate a more powerful parametric statistical analysis. Furthermore, because of the small sample size, there was a predilection for the occurrence of type II errors.[24]

Time. This study was interrupted by public holidays and other, similar disruptions that affected the regularity of the treatment intervals. Although the patients were seen over a set period of 4 weeks, we believe that a more exact treatment schedule might eliminate irregular intervals as an uncontrolled variable.

Patient activity. In an ideal setting, the participating patients would be prevented from performing the activities that led to the sprain (Table 8) and/or any activities that might have interfered with the results by putting the patient at further risk for aggravating the symptoms and thereby affecting the final outcome.

Follow-up period. A follow-up period of 6 months or longer is recommended. This would give a clearer indication of the long-term benefits associated with the treatment. It is suggested that follow-up periods of less than 1 year make detection of late outcomes of functional instability and recurrent sprains more difficult.[1]

Discussion of Statistical Analysis

Intergroup analysis. Between the adjustment group and the placebo group, significant differences in favor of the former were detected in terms of pain experienced (quality and intensity) at the final treatment and at the 1-month follow-up (Table 9). A significant difference was found in favor of the adjustment group in ankle dorsiflexion range of motion at the 1-month follow-up. Significant differences in favor of the adjustment group were also detected in terms of overall ankle functioning at the final treatment and at the 1-month follow-up.

A power analysis of the data revealed statistical differences between the adjustment group and the placebo group

Table 11. *Results obtained from Wilcoxon signed rank tests within placebo group*

		Standard deviation		Standard error		Mean			
Group		1	2	1	2	1	2	*P* value*	Power
Treatment 1 and final treatment	McGill	0.1392	0.1697	0.03593	0.04200	0.2433	0.1713	.038	.2357
	NRS 101	12.7907	19.3038	3.3025	4.9842	30.7333	21.2667	**.007**	.3234
	Goniometer	5.2863	4.9203	1.3649	1.2704	6.6333	8.2667	.199	.1287
	Algometer	0.8498	0.9574	0.2194	0.2472	2.9267	3.8333	**.017**	.7490
	Functional	24.9046	16.6046	6.4303	4.2873	63.3333	79.0000	**.004**	.4916
Treatment 1 and 1-month follow-up	McGill	0.1392	0.1223	0.03593	0.03159	0.2433	0.1160	**.013**	.7342
	NRS 101	12.7907	15.6267	3.3025	4.0348	30.7333	16.8667	**.020**	.7269
	Goniometer	5.2863	3.9279	1.3649	1.0142	6.6333	8.00	.181	.1157
	Algometer	0.8498	1.1482	0.2194	0.2965	2.9267	3.8600	**.020**	.6833
	Functional	24.9046	12.5167	6.4303	3.2318	63.3333	82.3333	**.005**	.7206
Final treatment and 1-month follow-up	McGill	0.1627	0.1223	0.04200	0.03159	0.1713	0.1160	.133	.1730
	NRS 101	19.3038	15.6267	4.9842	4.0348	21.2667	16.8667	.262	.0974
	Goniometer	4.9203	3.9279	1.2704	1.0142	8.2667	8.000	.806	.0526
	Algometer	0.9574	1.1482	0.2472	0.2965	3.8333	3.8600	.909	.0505
	Functional	16.6046	12.5167	1.2873	3.2318	79.0000	82.3333	.364	.0885

*Statistically significant results appear in bold type.

in terms of pain (quality and intensity), ankle dorsiflexion range of motion, and ankle function. These differences were evident at the final treatment in terms of pain perception and overall ankle function, and they were also evident at the 1-month follow-up in terms of pain perception, ankle dorsiflexion range of motion, and ankle function.

This leads to the conclusion that adjusting the ankle was superior to placebo treatment in subjective, objective, and functional terms when the 2 groups were compared.

Intragroup analysis for the adjustment group. Statistical analysis within group 1 (Table 10) showed significant improvements in terms of pain experienced (quality and intensity) between treatment 1 and the final treatment, between treatment 1 and the 1-month follow-up, and between the final treatment and the 1-month follow-up. Significant differences were observed in percentage pain intensity between treatment 1 and the final treatment and between treatment 1 and the 1-month follow-up. Significant differences were observed in ankle dorsiflexion range of motion between treatment 1 and the final treatment and between treatment 1 and the 1-month follow-up. Significant increases in pain threshold were measured between treatment 1 and the final treatment, between treatment 1 and the 1-month follow-up, and between the final treatment and the 1-month follow-up. Significant improvements in overall ankle function were observed between treatment 1 and the final treatment, between treatment 1 and the 1-month follow-up, and between the final treatment and the 1-month follow-up.

Intragroup analysis for the placebo group. Statistical analysis within group 2 (Table 11) showed significant improvements in terms of pain experienced (quality and intensity) between the final treatment and the 1-month follow-up. Significant differences were observed in percentage pain intensity between treatment 1 and the final treatment and between treatment 1 and the 1-month follow-up. Significant increases in pain threshold were measured between treatment 1 and the final treatment and between treatment 1 and the 1-month follow-up. Significant improvements in overall ankle function were observed between treatment 1 and the final treatment and between treatment 1 and the 1-month follow-up.

Table 12. *Average number of treatments for each group in sample of 30*

	Group 1	Group 2
Average no. of treatments	6.13	7.8

Power analysis revealed statistically significant improvements within the adjustment group in terms of pain (quality and intensity), goniometer readings, and overall ankle function after the treatment period. Significant changes between treatment 1 and the 1-month follow-up were found in percentage pain intensity experienced and pain quality and intensity experienced, dorsiflexion range of motion and pain threshold, and ankle function.

However, the placebo group did not show statistically significant changes (after power analysis) within the group in terms of subjective, objective, and functional findings.

CONCLUSION

There appear to be few studies and, except for functional exercises and surgical intervention, few suggested treatment protocols for chronic inversion ankle sprains. In our opinion, subacute and chronic grade I and grade II inversion ankle sprains can be improved in 6-8 manipulative treatments (Table 12), and this number could possibly be reduced and enhanced with the application of other conservative treatment modalities.

In view of the prevalence of ankle sprains and the many complications that can arise from inadequate management of such sprains, the ability to decrease pain, increase mobility, and improve overall ankle function over short-term and long-term periods can have major implications when these sprains are being managed.

From the discussion it should be noted that there appears to be strong evidence that adjusting the ankle may be an effective intervention for the treatment of subacute and

chronic grade I and grade II ankle inversion sprains. This pilot study thus appears to indicate that the mortise separation adjustment is superior to placebo (detuned ultrasound therapy). It may also be effective in short-term treatment and even long-term management of ankle sprains.

The significant findings of this study can, however, be thought of as extremely encouraging in the field of chiropractic research, especially in the relatively unexplored field of managing extravertebral conditions and with respect to the role that chiropractic can play in such management.

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