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ORIGINAL ARTICLE

Ultrasound-guided Injection of Platelet-rich Plasma Versus Dextrose 5 % in Chronic Achilles Tendinopathy: A Comparative Study

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Abstract

Background: **A persistent musculoskeletal condition called Achilles tendinopathy, which frequently affects the tendon's insertion.**

Aim and objectives: **Comparing effectiveness and safety of high-resolution ultrasound-guided platelet-rich plasma injection versus 5 % dextrose in the treatment of chronic Achilles tendinopathy.**

Patients and methods: **A blinded, randomized controlled trial, where 30 of diseased persons with chronic heel pain shared and equally distributed to double collections. Each collection includes 15 of patients and each of them is injected with dextrose 5 % or platelet-rich plasma with evaluation of the pain.**

Results: **In group 1, the mean pain score after the operation (VAS) (before) was 8.1 ± 1.22; the mean after was 2.35 ± 0.35. In group 2, the mean pain score after the operation (VAS) (before) was 8.2 ± 1.30, and the mean after was 2.32 ± 0.42. In each group, the pain score after surgery showed a highly significant difference between before and after (VAS).**

Conclusion: **The evaluated variables with the positive and negative results of the ultrasound-guided PRP injections showed quite effective results and stable outcomes for the treatment of chronic Achilles tendinopathy.**

Keywords: Achilis tendinopathy, Platelet-rich plasma, Ultrasound-guided, VAS score

1. Introduction

A persistent musculoskeletal condition called Achilles tendinopathy frequently affects the tendon's insertion. Running overuse is typically one of the risk factors, along with trauma, bad exercise, rheumatoid arthritis, and steroid drugs. As a result of chronic or repetitive overload and failure of the natural healing process, the etiology may first manifest as disintegration or microtears through the tendon.[1] (see Figs. 1–6).

Usually, tendinopathy affects the hypovascular region 2–6 cm in front of the calcaneus insertion. In clinical practice, a number of therapy approaches have been used, primarily nonoperative ones such as eccentric strengthening exercises, shockwaves, nonsteroidal anti-inflammatory drugs, and local steroid injections. None of these methods, nevertheless, were thought to be effective. In recent years, autologous blood and platelet-rich plasma (PRP) have become increasingly popular. PRP has a highly concentrated platelet content as compared with plasma and contains a number of cytokines that serve as growth factors and cell adhesion molecules. In the foot and ankle, tendinopathy and tenosynovitis are extremely frequent.[1]

They may be brought on by inflammatory arthritis, chronic repetitive stress, mechanical reasons,

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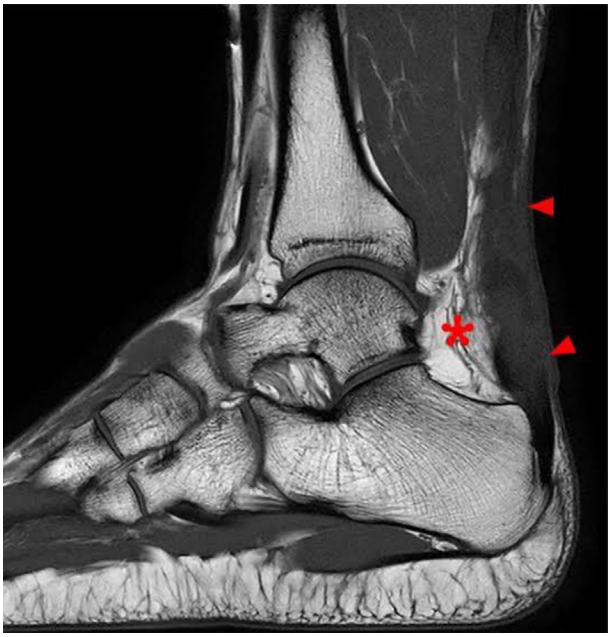

Fig. 1. Substantial change between before and after.

overuse injuries, or all three. In the foot and ankle, tendinopathy and tenosynovitis are extremely frequent. They may be brought on by inflammatory arthritis, chronic repetitive stress, mechanical reasons, overuse injuries, or all three. Tendinopathy from previous surgery is another possibility, particularly in instances of ankle fractures where internal fixation devices caused tendon impingement. An ankle and foot tendon lesion is visualized using MRI and ultrasound for diagnostic reasons.[1]

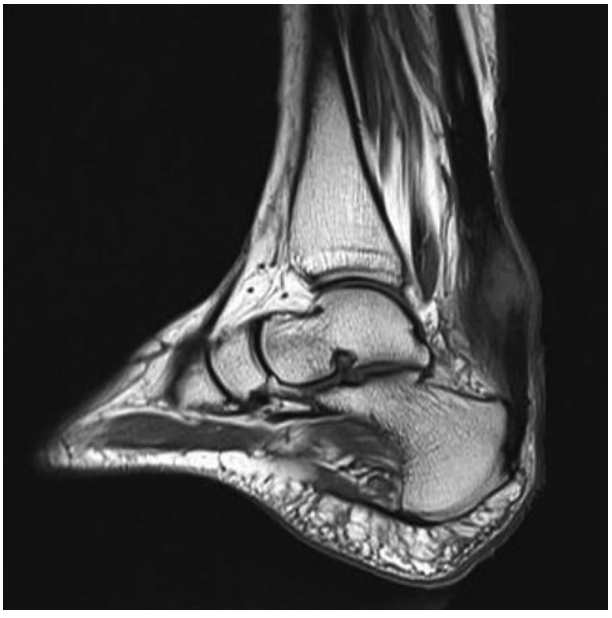

Fig. 2. Increased intratendinous signal and tendon enlargement, with edema.

Before the injection, target sites should be identified using Doppler imaging to detect areas of enhanced neovascularity and identify adjacent vascular structures. The ideal needle entry site and needle path must be chosen before skin preparation.[2]

The injection is carried out with a 23-gauge needle under sterile circumstances, and the probe can be positioned either axially or longitudinally while being guided directly by ultrasound. A significant synovial sheath effusion may be aspirated before injection. The two corticosteroids that are used most commonly in most institutions are methylprednisolone acetate and triamcinolone acetonide. These are frequently used in conjunction with a local anesthetic, usually a long-lasting anesthetic like ropivacaine or bupivacaine 0.25 % or a local anesthetic like lidocaine 1 %.[3]

With the help of ultrasound, therapeutic actions can be guided, guaranteeing that the correct site of pathology will receive therapy. The intended therapeutic goals of treatments can be generally characterized, although some may work through multiple potential methods.[4]

With regard to curing chronic Achilles tendinopathy, the goal of the study was to contrast high-resolution ultrasound-guided platelet-rich plasma injection with 5 % dextrose.

2. Patients and methods

This study was conducted between March 2021 and October 2022, on 30 participants attending the outpatient clinics of the Diagnostic Radiology Department in Sayed Galal Hospital, Al-Azhar University during the time of the study.

Patients were referred from El Hussein Orthopedic's outpatient clinic. Thirty patients with chronic heel pain were divided into two groups: **Group A:** 15 patients for injection of dextrose 5 %. **Group B:** 15 patients for injection of platelet-rich plasma.

Inclusion criteria: The affected ankle joint's range of motion is severely limited, and conservative therapies including physiotherapy, oral analgesics, and blind steroid injections have failed to relieve the pain.

Exclusion criteria: Patients who are malignant, infected locally, have autoimmune inflammatory disorders, have poor physical and mental health, or who refuse to participate.

2.1. Methods

All patients included in the study were subjected to the following:

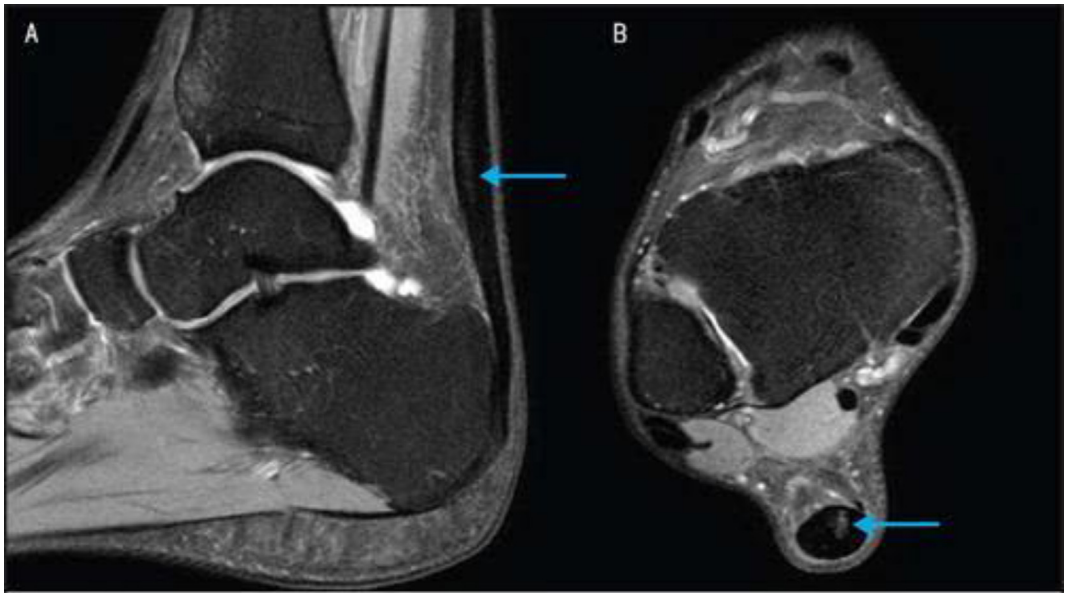

Fig. 3. Also, note findings consistent with retrocalcaneal bursitis.

Detailed history taking including: Personal history (name, age, and sex), complaint of the patient, present history, and history.

2.2. Careful clinical examination

2.2.1. General

Assessment of the cardiovascular, neurological, respiratory, and blood pressure systems.

2.2.2. Local

We may use a subjective description of pain that developed gradually and was felt 2–6 cm from the insertion of the Achilles tendon to identify Achilles tendinopathy. During the objective examination, it is essential to examine the lower leg as a whole. It is possible to identify any muscle imbalances and biomechanical issues by looking at the hip and the knee. Some of the more specific contributing and resulting factors we look for in the foot and ankle are muscular atrophy, edema, asymmetry, joint effusions, and erythema. A key marker of how long the tendinopathy has existed is atrophy, which is typically seen with chronic disorders. Testing for flexibility, strength, and range of motion is usually limited on the tendinopathy side as a positive arc sign and favorable test findings from the Royal London Hospital. Physical performance evaluations, such as the hop and heel-raise endurance tests, may be used to check a patient's functional condition as required and record the findings.

2.2.3. Investigations

Complete blood count (CBC), serum creatinine, and the following liver function tests are run: AST, ALT, ALP, serum bilirubin, prothrombin time, and INR. HBA1C for diabetic patients.

Preinjection radiograph, ultrasound, and MRI evaluation.

Positioning of the patient, sterilization, and injection.

Postinjection evaluation clinically.

2.2.4. Ethical consideration

An official permit was obtained from the orthopedics and diagnostic radiology departments and formal approval from the Institutional Research Board (IRB). All participants gave their informed consent after being told of the purpose, methodology, and any applicable goals of the study.

2.2.5. Data management and statistical analysis

Using SPSS version 20, data entry, processing, and statistical evaluation were finished (Statistical Package for the Social Sciences). The Kruskal-Wallis, Wilcoxon, Chi-Square, logistic regression analysis, and Spearman's correlation significance tests were applied. The type of data (parametric and nonparametric) acquired for each variable was reported, and the appropriate analysis was carried out. The threshold for statistical significance was a P value of 0.05 or less (5 %). The Kruskal-Wallis test was used to determine whether a difference in a nonparametric variable between more than two research groups was statistically significant. For variables

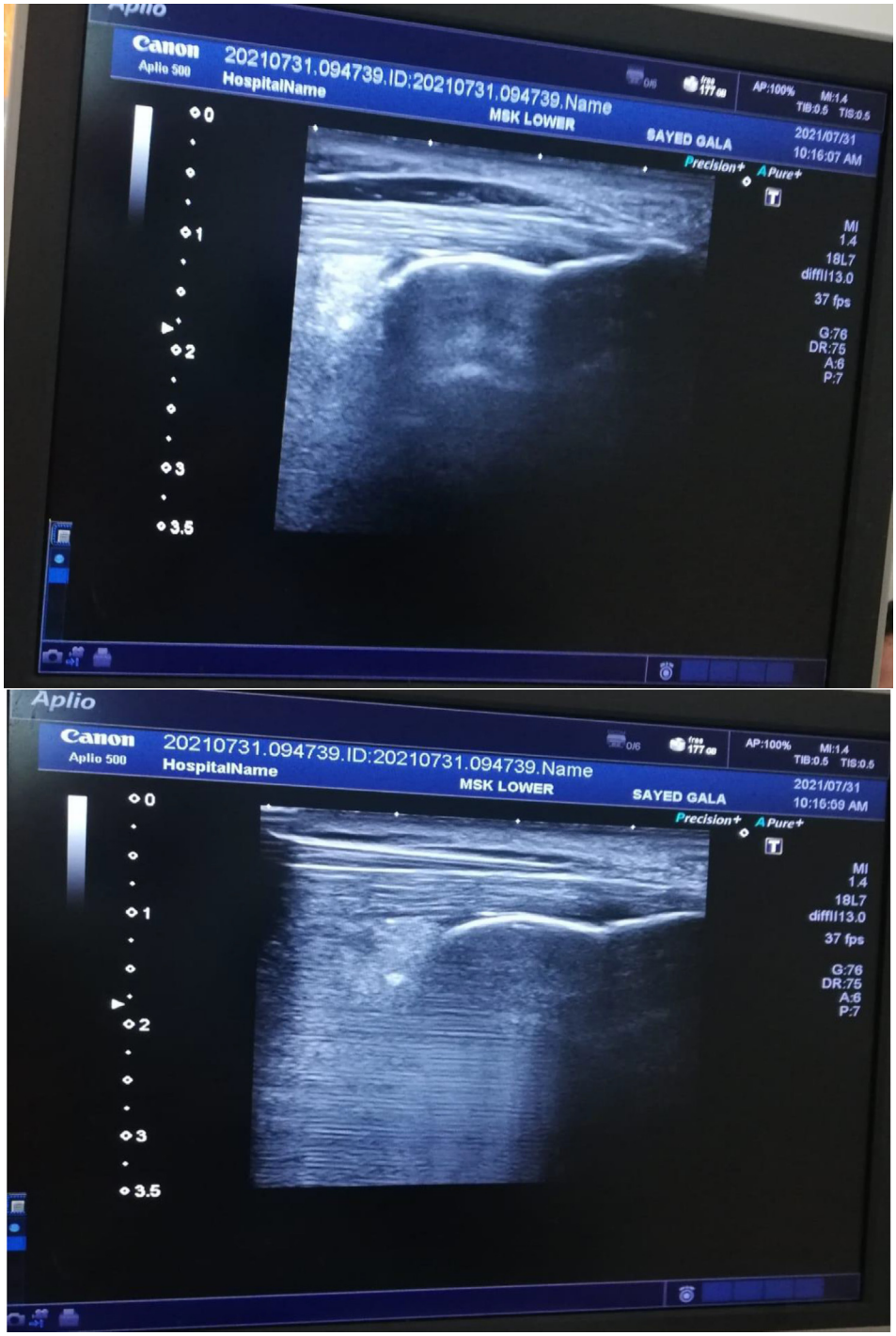

Fig. 4. Large mucoid patches and vacuoles are seen between the thinned degenerated tendon fibers Male 65 yrs pre injection.

with a continuous normal distribution, an ANOVA in one direction was followed by a post hoc analysis using the Tukey test, and the Mann–Whitney *U* test was used after the Mann–Whitney test.

3. Results

Table 1 shows the demographic characteristics among the two studied groups. The mean age was 45.5 ± 3.32 in group 1 and 45.6 ± 3.22 in group 2. There were 46.7 % who were male in group 1 and 40 % in group 2. There was no significant difference between both groups as regards demographic characteristics.

Table 2 shows complete blood count variables among the studied groups. In group A, the mean PLT was 405.7 ± 135.69, the mean Hb was 11.41 ± 0.94, and the mean **WBC** was 6.86 ± 0.75 in

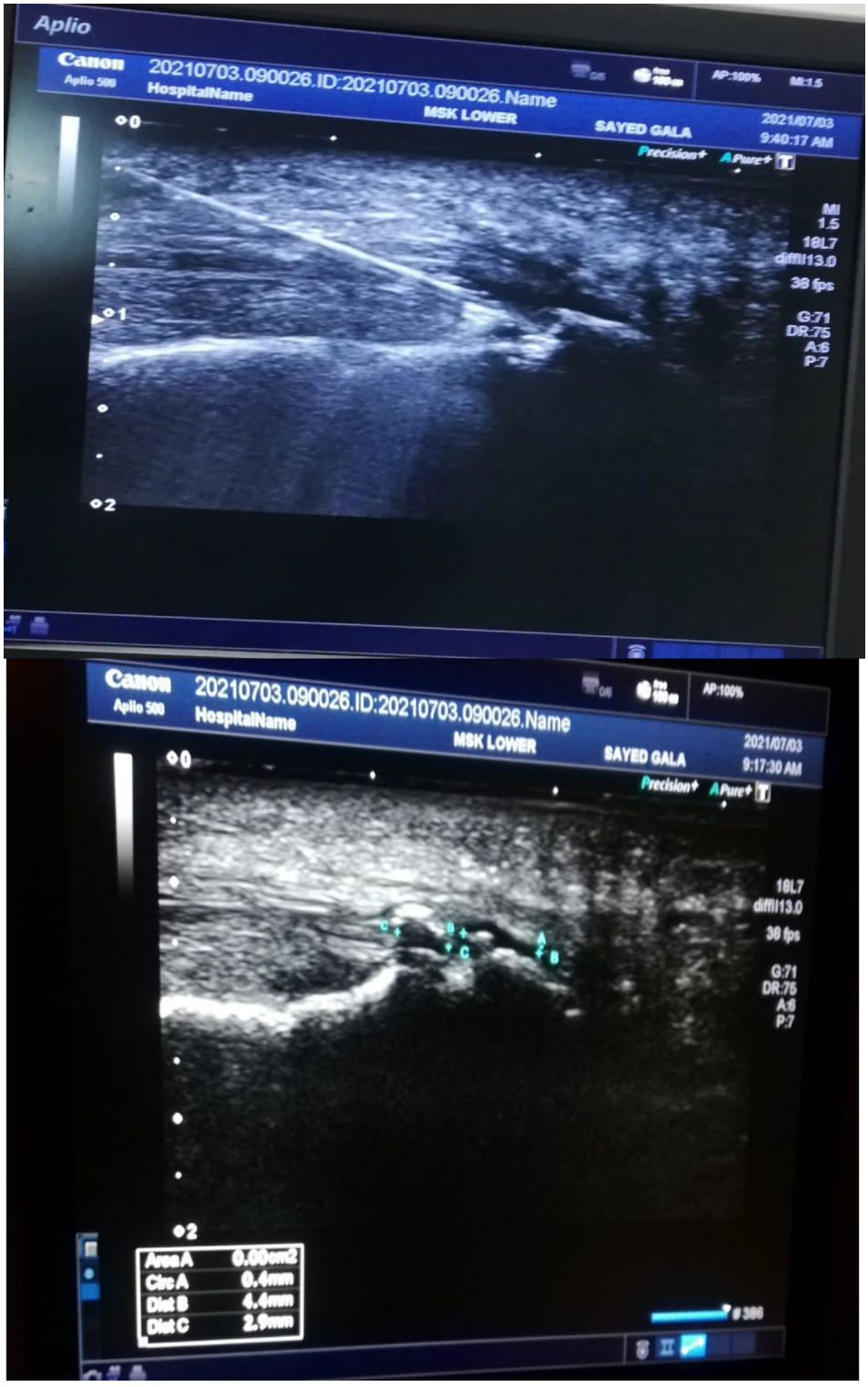

Fig. 5. 42 yrs male pre injection.

group A. The mean **INR** was 1.04 ± 0.04, the mean blood urea was 23.8 ± 7.26, and the mean serum creatinine was 0.73 ± 0.13. The mean **AST** was 85.85 ± 8.55 and the mean **ALT** was 95.20 ± 10.18. The mean T. bilirubin was 2.1 ± 0.4. The mean HbA1C was 5.85 ± 0.45, the mean triglyceride level was 92 ± 8.45, and the mean cholesterol was 180 ± 10. In group B, the mean PLT was

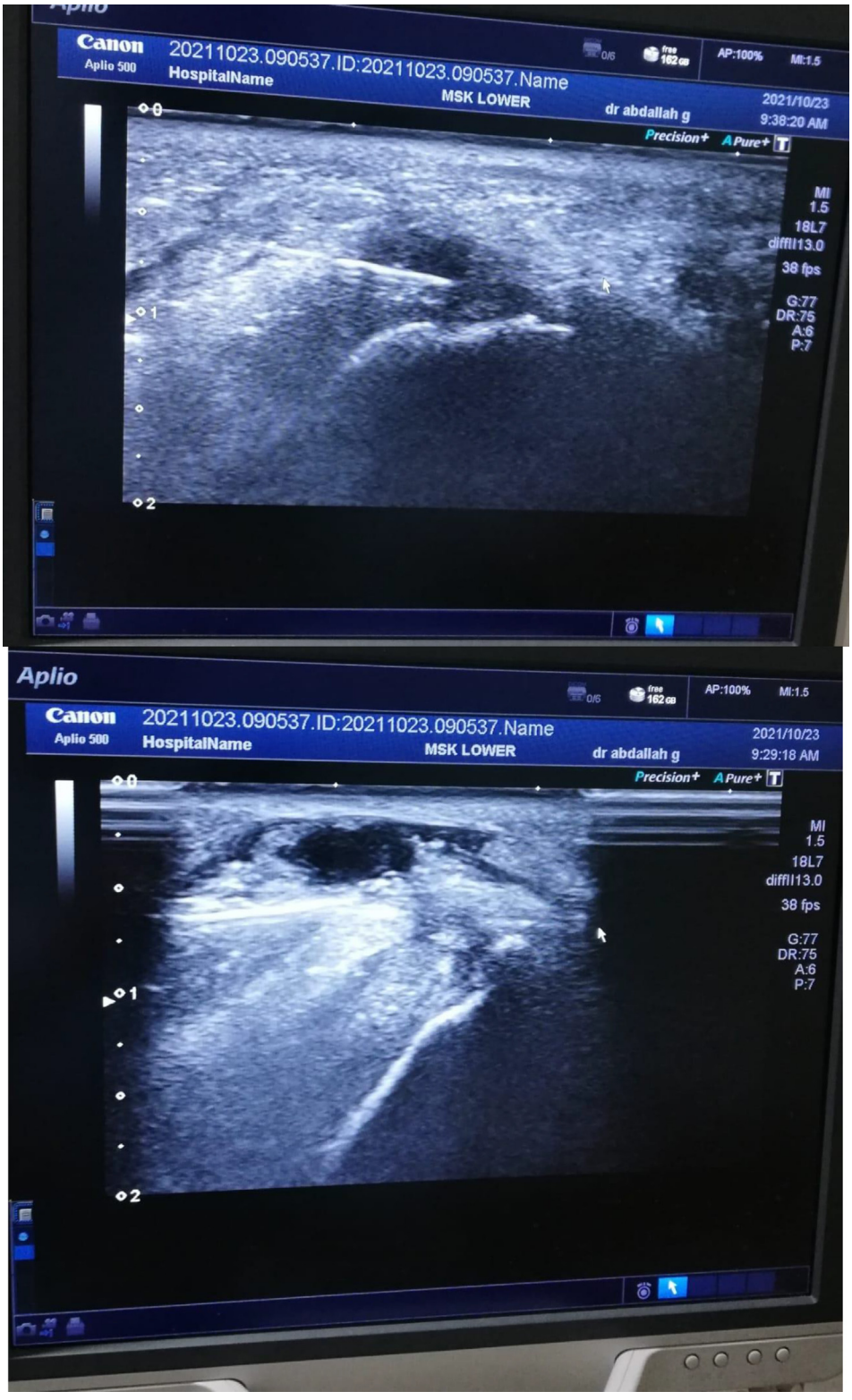

Fig. 6. Pre and post 45 years female dextrose injection post injection diabetic.

401.22 ± 128.12, the mean Hb was 11.53 ± 0.98, and the mean **WBC** was 6.75 ± 0.65 in group A. The mean **INR** was 1.05 ± 0.06, the mean blood urea was 23.55 ± 7.22, the mean serum creatinine was 0.75 ± 0.11, the mean **AST** was 84.94 ± 8.1, the mean **ALT** was 92.35 ± 8.54, and the mean T. bilirubin was 2.05 ± 0.35. The mean HbA1C was 5.82 ± 0.72, the mean triglyceride level was 91 ± 8.1, the mean

Table 1. Demographic characteristics among the studied groups.

	Group 1 ($n = 15$) N (%)	Group 2 ($n = 15$) N (%)	Test value	P value
Sex				
Male	7 (46.7 %)	6 (40 %)	$X^2 = 0.13$	0.71
Female	8 (53.3 %)	9 (60 %)		
Age	45.5 ± 3.32	45.6 ± 3.22	1.06	0.91

P value < 0.05 is significant, P value < 0.01 is highly significant.
SD, Standard deviation.
^{Z}MWU = Mann–Whitney U test.
X^2 = Chi-square test.

Table 2. Routine laboratory workup among the studied groups.

		Group 1 ($n = 15$)	Group 2 ($n = 15$)	Test value	P value
PLT (/cm3)	Mean ± SD	405.7 ± 135.69	401.22 ± 128.12	^{Z} = MWU 1.12	0.75
Hb (g/dl)	Mean ± SD	11.41 ± 0.94	11.53 ± 0.98	^{Z} = MWU 1.08	0.76
WBC (/cm3)	Mean ± SD	6.86 ± 0.75	6.75 ± 0.65	1.33	0.40
INR	Mean ± SD	1.04 ± 0.04	1.05 ± 0.06	2.25	0.08
Blood urea	Mean ± SD	23.8 ± 7.26	23.55 ± 7.22	1.01111	1
Serum creatinine	Mean ± SD	0.73 ± 0.13	0.75 ± 0.11	1.396	0.32

P value < 0.05 is significant, P value < 0.01 is highly significant.
SD, Standard deviation.
^{Z}MWU = Mann–Whitney U test.

cholesterol was 175 ± 9. There was an insignificant difference between both groups as regards routine laboratory workup.

Table 3 shows ultrasound findings before injection. In group 1, before injection, there were 10 cases with tendinitis/bursitis, 7 with partial tear, 4 with calcification, 4 with effusion, and 1 with full-thickness tear. In group 1, after injection, there were four cases with tendinitis/bursitis, 6 with partial tear, 4 with calcification, 2 with effusion, and 1 with full-thickness tear. In group 2, before injection, there were eight cases with tendinitis/bursitis, 8 with partial tear, 5 with calcification, 5 with effusion, and 1 with full-thickness tear. In group 2, after injection, there were five cases with tendinitis/bursitis, four with partial tear, five with calcification, 1 with effusion, and 1 with full-thickness tear. There was a significant difference in tendinitis and bursitis before and after injection (Table 4).

In group 1, the mean pain score after the operation (VAS) (before) was 8.1 ± 1.22, the mean after was 2.35 ± 0.35. In group 2, the mean pain score after the operation (VAS) (before) was 8.2 ± 1.30 and the mean after was 2.32 ± 0.42. In each group, there was a very substantial difference between before and after in terms of the pain score after operation (VAS).

Table 5 shows the range of motion (ROM) of the study group. In group 1, the mean flexion before was

Table 3. Ultrasound findings before injection.

	Group 1 ($n = 15$)		Group 2 ($n = 15$)		Test value	P value
	Before	After	Before	After		
Tendinitis/bursitis	10	4	8	5	0.55	0.45
P0 (before and after)	**0.02**		0.27			
Partial tear	7	6	8	4	0.13	0.71
P0 (before and after)	0.71		0.13			
Calcification	4	4	5	5	–	–
P0 (before and after)	–		–			
Effusion	4	2	5	1	0.15	0.69
P0 (before and after)	0.3613		0.06			
Full-thickness tear	1	1	1	1	–	–
P0 (before and after)	–		–			

P value < 0.05 is significant, P value < 0.01 is highly significant.
SD, standard deviation.
X^2 = Chi-square test.

Table 4. Pain score after operation (VAS) among the studied cases.

	Group 1 ($n = 15$)	Group 2 ($n = 15$)	Test value	P value
VAS				
Before	8.1 ± 1.22	8.2 ± 1.30	1.135	0.81
After	2.35 ± 0.35	2.32 ± 0.42	1.106	0.85
P0 (before and after)	**0.00003**	**0.0001**		

P value < 0.05 is significant, P value < 0.01 is highly significant.
SD, Standard deviation.
^{Z}MWU = Mann–Whitney U test.

Table 5. Range of motion (ROM) of the studied group.

Range of motion (ROM)	Group 1 ($n = 15$)	Group 2 ($n = 15$)	Test value	P value
Flexion before	61 ± 14.1	70 ± 13.2	1.141	0.8
After	121 ± 23.1	124.3 ± 25.4	1.209	0.72
P	0.07	**0.01**		
Extension before	22.8 ± 7.12	22.5 ± 9.15	1.65	0.35
After	37.85 ± 6.42	35.72 ± 8.42	1.72	0.32
P	0.7	0.76		
Abduction before	54.31 ± 19.2	59 ± 23.5	1.49	0.45
After	122.1 ± 31.92	115.2 ± 68.21	4.56	**0.007**
P	0.06	0.26		
Ext. rotation before	23.71 ± 13.98	25.22 ± 11.65	1.44	0.5
After	45.62 ± 10.8	44.5 ± 14.1	1.70	0.32
P	0.34	0.48		

P value < 0.05 is significant, P value < 0.01 is highly significant.
SD, standard deviation.
^{Z}MWU = Mann–Whitney U test.

61 ± 14.1, extension before was 22.8 ± 7.12, abduction before was 54.31 ± 19.2, and Ext.-rotation before was 23.71 ± 13.98. In group 1, the mean flexion after was 121 ± 23.1, extension after was 37.85 ± 6.42, and abduction after was 122.1 ± 31.92. Ext.-rotation after was 45.62 ± 10.8. In group 2, the mean flexion before was 70 ± 13.2, extension before was 22.5 ± 9.15, abduction before was 59 ± 23.5, and ext.-rotation before was 25.22 ± 11.65. In group 1, the mean flexion after was 124.3 ± 25.4, extension after was 35.72 ± 8.42, and abduction after was 115.2 ± 68.21, and ext.-rotation after was 44.5 ± 14.1. Regarding flexion, there was a substantial change between before and after.

4. Discussion

The goal of prolotherapy is to encourage the formation of healthy cells and tissues by injecting small amounts of an irritating solution into painful and injured ligaments, joints, entheses, and surrounding joint regions over the course of many treatment sessions.[5]

This study's primary objective was to assess the effectiveness and safety of high-resolution ultrasound-guided platelet-rich plasma injection against 5 % dextrose in treating chronic Achilles tendinopathy.

This clinical trial was conducted on patients who visited the Diagnostic Radiology Department's outpatient clinics at Bab El Sharia University Hospitals, Al-Azhar University in Cairo. El Hussein Orthopedic's outpatient clinic refers patients. Thirty patients with chronic heel pain were split into two groups of 15 each, each receiving injections of platelet-rich plasma or 5 % dextrose. The trial lasted somewhere between 6 and 12 months. To the best of our knowledge, to treat chronic Achilles tendinopathy, this study is the first to evaluate the safety and efficacy of high-resolution ultrasound-guided platelet-rich plasma injection versus 5 % dextrose. No previous research of this kind was done. Regarding the demographic features of the two study groups, the average age in groups 1 and 2 was 45.5 ± 3.32 and 45.6 ± 3.22, respectively. In group 1, 46.7 % of the participants were male.

In group 2, 40 % of the participants were men. Between the two groups, demographic traits were not significantly different.

Our results were corroborated by research by **Kearney *et al.***[6] comparing the results of a single platelet-rich plasma injection to a sham injection in individuals with Achilles tendinopathy. The median (SD) age of the study's participants was 52.2 (10.5) years, and 58 % of them (138/230) were female, with

no discernible difference between the two collections.

Furthermore, the **Tamam** *et al.*[7] experiment looked into how dextrose injections affect the pain of people with Achilles tendinopathy.18 people made up the study sample (13 female and 5 male). The individuals' ages ranged from 18 to 52 years, with an average age of 34.89 years and an SD of 12.04 years.

The current study showed that with regard to ultrasound findings before injection, in group 1, before injection, there were 10 cases of tendinitis or bursitis: 7 with partial tears, 4 with calcification, 4 with effusion, and 1 with full-thickness tears. In group 1, after injection, there were 4 cases of tendinitis or bursitis: 6 with partial tears, 4 with calcification, 2 with effusion, and 1 with a full-thickness tear. In group 2, before injection, there were 8 cases of tendinitis or bursitis: 8 with partial tears, 5 with calcification, 5 with effusion, and 1 with a full-thickness tear. In group 2, after injection, there were 5 cases of tendinitis or bursitis: 4 with partial tears, 5 with calcification, 1 with effusion, and 1 with full-thickness tears. Regarding tendinitis and bursitis, there was a noticeable difference between before and after the injection.

The Ibrahim *et al.*,[8] study, which found a significant decrease in the prevalence of tendinitis and bursitis after injection based on ultrasound findings, confirmed our findings.

In additionally, after the 20-day follow-up, according to **Ferrero** *et al.*,[9] Although tendon thickness did not significantly decrease from baseline, it did so statistically during the 6-month follow-up. Following the 20-day and 6-month checks, respectively, intratendinous vascularity significantly increased in comparison to baseline. Magnetic resonance and ultrasound measurements of tendon thickness had very good agreement (intraclass correlation coefficient: 0.986).

In the study in our hands, as regards pain score after operation (VAS) among the studied cases, in group 1, the mean pain score after operation (VAS) (before) was 8.1 ± 1.22; the mean after was 2.35 ± 0.35. In group 2, the mean pain score after operation (VAS) (before) was 8.2 ± 1.30 and the mean after was 2.32 ± 0.42. Regarding pain score after operation (VAS), there was a highly significant difference between before and after in each group.

According to the **Albano** *et al.*[10] study, the mean VAS significantly decreased from the baseline evaluation at 6 months to the last evaluation at pretreatment (6.4 ± 1.4), validating our findings.

According to **Krogh** *et al.*,[11] at 3 months, there was no difference between the PRP and saline groups in any of the three pain measurements (pain while walking, discomfort with compression of the Achilles tendon, and pain at rest). Walking caused a difference of 0.8 (95 % CI, −1.8 to 3.3; $P = 0.544$). Pain while pinching the Achilles tendon caused 0.3 (95 % CI, −0.2 to 0.9); the mean difference between the PRP and saline groups was 1.6 (95 % CI, −0.5 to 3.7; $P = 0.137$).

A dose of 0.5 ml or less of dextrose (25 %) was injected using an ultrasound monitor at 1 to 3 locations inside the tendon at the sites of degeneration (hypoechogenicity or tear).

According to **Ryan** *et al.*,[12] in each session neovessels were still present in 60/108 instances (56 %) at a mild to moderate degree at the mean 28-week ultrasonography follow-up; however, the clinical discomfort was still relieved.

Similar to this, **Tamam**[7] showed that there was a statistically significant improvement in the VAS scale; the initial score was 8.83 ± 0.8 (minimum: 7, maximum: 10), followed by 4.94 ± 0.78 (minimum: 4, maximum: 6) after 4 weeks, and 1.1 1.1 (minimum: 0, maximum: 3) after 12 weeks.

Our findings indicated this in relation to the study group's range of motion (ROM).

The mean flexion before was 61.41, the mean extension before was 22.8 7.12, the mean abduction before was 54.31 19.2, and the mean extension−rotation before was 23.71 13.98 in group 1. The mean flexion after exercise was 124.3 25.4, the mean extension after exercise was 35.72 8.42, the mean abduction after exercise was 115.2 68.21, and the mean extension−rotation after exercise was 44.5 14.1. Regarding flexibility, there was a really substantial change between before and after.

Bae *et al.*[13] meta-analysis includes trials of 750 participants from 10 different investigations. In comparison to saline injection and exercise, between 6 months and 1 year after treatment, dextrose prolotherapy significantly decreased pain scores (SMD −0.44; 95 % CI −0.76 to −0.11, $P = 0.008$).

At 6 months, a higher percentage of individuals in the platelet-rich plasma group reported receiving results they were satisfied with, according to **Abate** *et al.*,[14] but there were no differences in the function between the groups at 3 and 6 months. Younger patients had better outcomes, with a superior improvement in the function and in line with the percentage of successful outcomes.

The possible applications of PRP range from tendinopathy and osteoarthritis treatment to skin and wound healing. PRP therapy is gaining popularity as a treatment for tendinopathy. Growth factors that could encourage a healing response include platelet-derived growth factor (PDGF), transforming

growth factor (TGF), and insulin-like growth factor. The fact that PRP is autologous, which is thought to have nearly no adverse effects, is one of its key benefits.[15]

Even when given intravenously, dextrose is a very safe substance. Repetitive motion tendinopathies and overuse injuries share similar traits, regardless of location.[16]

4.1. Conclusion

Ultrasound-guided injections of PRP produced sustained outcomes up to a medium-term follow-up for the treatment of chronic Achilles tendinopathy. Under US guidance, PRP injections into the tendon are done with great accuracy and effectiveness.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

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Conflicts of interest

There are no conflicts of interest.

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