The Bone & Joint Journal

Age and Symptom Severity as Predictors of Outcomes Following Shockwave Therapy in Achilles Tendinopathy: A single centre observational study

Journal:	*The Bone & Joint Journal*
Manuscript ID	BJJ-2025-0706.R1
Manuscript Type:	Original Article
Keywords:	Achilles tendinopathy, Shockwave therapy, Predicting outcome of treatment, ESWT

ABSTRACT

Aim

This study aimed to determine the factors associated with positive outcomes from Extracorporeal Shock Wave Therapy (ESWT) in patients with chronic Achilles tendinopathy and to develop and evaluate a simple predictive model for clinical use.

Methods: An observational study was carried out on patients with chronic Achilles tendinopathy, managed through the therapist-led Tendo Achilles Pathway (TAP), who did not respond to physiotherapy and podiatry. Logistic regression was utilised with potential predictors including age, gender, symptom duration, athletic status, type of onset, use of insoles, bilateral symptoms, body side and symptom location, neovessel presence, and severity measurements (VISA-A and VAS).

Results: The sample (N=183) were mostly female (60%), had a median age of 53 and had experienced symptoms from 3 months to 14 years with pain most commonly reported in the tendon body (57%). Thirty percent were athletes, 55% wore insoles, and 89% had insidious onset. Mean (SD) baseline VAS and VISA-A scores were 57 (23) and VISA-A 33 (17) respectively. ESWT led to positive outcomes in 46% and only milder initial symptoms and greater age were associated with better outcomes ($p<0.05$).

Conclusion: This study presents an analysis of the rate and determinants of positive outcome at three months following ESWT in patients with Achilles Tendinopathy. Age and symptom severity emerged as significant predictors of positive treatment success. Furthermore, we developed a very simple predictive model with potential clinical utility.

INTRODUCTION

Chronic Achilles tendon pain and stiffness are common in both athletes and non-athletes, affecting about 150,000 people annually in the UK (1). The causes of Achilles tendinopathy remain unclear, with various theories proposed to explain its symptoms (2)(3). There is currently no standard treatment, so multiple surgical and non-surgical options are used.

The optimal management strategy remains unclear. Orthopaedic specialists typically prioritise conservative interventions before considering surgical options. Protocols commonly beginning with minimally invasive and less expensive treatments before advancing to more invasive and costly treatments. Physiotherapy is generally employed as the initial modality although. there is currently insufficient evidence to determine which approach is most effective for chronic cases. Physiotherapy treatment therefore often encompasses a variety of modalities including patient education, activity modification, graded loading regimens, strength and flexibility exercises, manual therapy, and both eccentric and concentric training based on clinical evaluation. Podiatric consultation may also be included for footwear recommendations (1). Where appropriate, Extracorporeal Shock Wave Therapy (ESWT) and injection therapies can be considered in subsequent stages, with surgical procedures usually reserved for refractory cases (4) (2).

ESWT gained national and international interest following the guideline publication by the National Institute for Health and Clinical Excellence (NICE) in 2009 (3). ESWT is a procedure where shock waves are applied to the target tissue, using a hand probe. The shockwaves are mechanical, audible, low energy sound waves (4). Mechanisms behind the effects of ESWT are not fully understood but it has been speculated that in the short term it produces an immediate analgesic effect by altering the permeability of neuron cell membranes and in the long term micro trauma triggers the production of inflammation, enhanced blood flow, release of growth factors and activation of stem cells to address pain and facilitate tissue repair (4). There are also suggestions that the shockwaves can 'breakdown' disorganised tissue and calcifications (5).

ESWT is less invasive and cheaper than injection therapy or surgery, allowing patients to maintain normal activities with rare serious complications. However, it faces high equipment and staff costs, takes several weeks to administer, can be painful, isn't recommended for acute conditions, and shows inconsistent results. There are studies demonstrating no or limited improvement (6-8) and others supporting the use of ESWT (9-11).

These inconsistent and unpredictable outcomes complicate clinical management. While lower-level modalities may benefit some patients, they can also cause delays and waste resources. One reason for these inconsistencies may be individual patient characteristics affecting treatment success. A prognostic model could guide clinicians on the likelihood of a positive outcome for ESWT for each patient.

A search of the literature found a single study which had investigated this area, published as an abstract presentation (10) (2023 AOSSM Annual Meeting). The authors concluded that predictors of poor outcomes for ESWT and Achilles tendinopathy include elevated BMI and MRI severity. No peer reviewed publications were found.

Aims of the study

The aims of this study were threefold.

1. To document the frequency of a positive outcome with ESWT.
2. To determine whether the outcome of ESWT for Achilles tendinopathy is predictable from patient characteristics using easily available patient data.
3. To construct and validate a simple predictive model identifying patients unlikely to benefit from treatment based on the variables identified as part of aim 2.

MATERIALS AND METHODS

Data source

An observational study was conducted following the TRIPOD (Transparent Reporting of a multivariable prediction model for Individual Prognosis or Diagnosis) guidelines for the development and evaluation of prediction models (12). Ethical permission was not required, since it was classed as a service evaluation by the local ethics committee.

We implemented a Tendon Achilles Pathway (TAP) in our health board in 2008 (2). As part of the TAP patients referred to the Heel Pain Clinic were those that had not responded to physiotherapy and podiatry treatment, they were referred by the treating clinician when they had ongoing symptoms for which they wanted to undergo further, but different treatment.

Given the lack of a clearly established consensus on optimal physiotherapy and podiatry treatment protocols, we developed and disseminated guidelines through our intranet to support clinicians. These guidelines emphasize systematic assessment and correction of biomechanical abnormalities, focus on proximal stability, and address muscle tightness or weakness. Recommended interventions may include manual therapy (such as deep friction massage), electrotherapy modalities, tendon loading and reloading protocols, and both eccentric and concentric exercise regimens. The treating therapist determines the most appropriate course of treatment following a comprehensive patient assessment. If, after six weeks of adherence to prescribed exercises and physiotherapy, there is no measurable improvement, ESWT is considered in consultation with the patient, along with referral to the HPC as appropriate.

Over an eight-year period, from June 2015 to May 2024 (with HPC services suspended during 2020–2021 due to COVID-19), all patients attending our HPC were evaluated by a senior physiotherapist specialising in foot and ankle injuries. Patients diagnosed with chronic Achilles tendinopathy (defined as at least three months of pain), based on both clinical assessment and ultrasound examination, were offered ESWT, provided there were no contraindications.

Contraindications included pregnancy, areas of malignancy or infection, age 18 years or under, cardiac pacemaker / heart valves, any injection to the tendon within the last 12 weeks (including steroid / dry needling / PRP injections) greater than 10 % tear of tendon identified on scan, haemophilia or prolonged on-going use of blood coagulation, joint replacements / metal implants in the area of treatment (13).

The clinical assessment was performed at the start of treatment and at 12 weeks after the first treatment. Clinical diagnosis required patient-reported pain and tenderness on palpation at the insertion (Achilles-calcaneum junction), the tendon body (2–6 cm above insertion), or both sites (15, 16).

Radiological confirmation using ultrasound to identify hypoechogenic areas within the tendon and loss of normal ribbon-like structure (17), and/or >50% increase in anteroposterior tendon thickness compared to the asymptomatic side in unilateral cases (18). Power Doppler ultrasound was also employed to assess neovessel presence.

All patients were consented to the ESWT treatment in accordance with the NICE guidelines i.e. the clinician explained the uncertainties about the treatment, the possible risks of the treatment including tendon rupture. The patient was also provided with the NICE guidance patient information sheet “Treating refractory Achilles tendinopathy using shockwave therapy” before obtaining written consent (3). An evaluation was also conducted on patient responses to treatment in accordance with NICE requirements.

Patient level demographic data was collected including gender, age, duration of symptoms, unilateral or bilateral symptoms, side of body affected (left / right), location of pain (tendon body, insertion or both), whether insoles had been issued to address foot posture abnormalities, the patient was athletic (defined as a person who self-reported as participating in structured physical activity, including for example any recreational or organised sports) and if the onset of symptoms was insidious. The presence or absence of neovessels detected via power doppler ultrasound scanning was also recorded.

The primary outcome measured was a composite binary variable: positive or negative treatment result. Positive outcomes was patients satisfaction at discharge, with no need for further treatment or referral; only these patients were discharged as positive cases. Any other situation—including ongoing issues, referral to a consultant, or progression within the treatment pathway—was considered negative.

The secondary outcome measures were the Victoria Institute of Sport Assessment – Achilles (VISA-A) questionnaire (shown to be validated and reliable outcome) (14), and a Visual Analogue Scale (VAS) for pain (the average it had been over the previous week) (15) were recorded at baseline and at the 12 week follow up.

All patients received ESWT using a standardised protocol. In a prone position with ankles at plantargrade, a trained physiotherapist applied gel to the Achilles and delivered treatment to the most tender area. Treatment parameters are detailed in table 1.

Parameters/Variable	**Description**
Shockwave Device	Swiss Dolorclast Classic -USA
Type of shockwave therapy	Radial
Time intervals between treatments	1 week
Total number of treatments	3
Local anaesthesia	None
Shockwave application	Area of maximal tenderness treated in a circumferential pattern, starting at the point of maximum tenderness
Total number of impulses per treatment	2400
Maximal positive pressure	2-3.5 bars
Impulse frequency	10 Hz
Other intervention	None

Table 1 ESWT parameters used

Patients did not receive additional alternative treatments during the ESWT treatment phase. However, they were permitted to continue any exercises or footwear adjustments previously recommended by physiotherapy or podiatry if they found these to be of some benefit.

Dataset

The original data set comprised 277 records. Where a patient appeared twice in this data set, with one record for each leg, one was chosen at random, reducing the sample to 209 records. The final outcome was unrecorded for 26 cases, resulting in an analysis sample size of 183.

Statistical Analysis

The primary dependent variable was the outcome of ESWT (positive or negative), a binary measure (patient discharged or not), and so Logistic Regression was used. Changes in symptom severity were assessed using paired t-tests since the scale of measurement was bounded and the large sample size ensured robustness. Correlations were measured with Pearson correlations.

Model building was performed using the backwards elimination approach. Since this study was part of an internal assessment of service delivery the sample was constrained by the availability of routinely collected data. Sample size recommendations for model building with Logistic Regression vary from 10 to 50 events per variable (EPV) with upper end of this range being preferable (16). The EPV for our predictive model was only around 11 so we followed published recommendations (16, 17) for checking the robustness of regression models and provide a brief summary of our findings in the 'Stability Investigation' section.

Results

Data Summary

Most patients were female (60%, 110/183, with a median (IQR) age of 53 years (15), ranging from 24 to 86 years. The duration of symptoms varied widely from 3 months to 14 years, with a median (IQR) of 17 (27) months. Pain locations reported included the tendon body (57%, 105/181), the insertion (37%, 67/181), and both

(5%, 9/161). Symptoms were evenly distributed between right and left legs. Nearly one-third of the sample described themselves as athletic (30%, 19/63), just over half wore insoles (55%, 54/99), and most cases had an 'insidious' onset of symptoms (89%, 54/61).

Patients reported baseline severity using both the VAS and VISA-A scales. Both scales are measured from 0 to 100, with VAS scores positively associated with pain (higher values indicating higher pain) and VISA-A scores negatively associated with severity (higher values indicating lower severity). Mean (SD) baseline scores for VAS and VISA-A were 57 (23) and 33 (17), respectively. Reported values covered nearly the entire range for both measures, with VAS and VISA-A minimum and maximum values of 2 to 100 and 0 to 75, respectively. The two patient-reported measures of baseline severity (VAS and VISA-A) were highly correlated, displaying a roughly linear relationship with a correlation coefficient of -0.512 ($p<0.001$).

Primary Outcome

Out of 183 patients, 46% (85/183) experienced a positive outcome with ESWT. The majority of these positive outcomes occurred after the first round of treatment (75%, 64/85), with an additional 24% after the second round of treatment. The single patient who proceeded to a third round of treatment also had a positive outcome. Refer to figure 1 for a summary of the positive and negative outcomes associated with ESWT.

Secondary outcome measures – VISA-A and VAS

Patients were assessed before treatment and then reviewed 12 weeks following the start of the treatment course. A summary of scores for both rounds of treatment can be found in Table 2 below.

Mean [95% CI]	Treatment	Before Treatment	After Treatment	Change	N	Significance of change
VAS	First	57 [53,60]	38 [34,43]	-19 [-22,-15]	170	<0.001
	Second	46 [39,52]	35 [26,43]	-11 [-19,-2]	41	0.008

VISA-A	First	33 [31-36]	46 [42,50]	12 [9,16]	165	<0.001
	Second	42 [35,48]	48 [41,55]	6 [0,12]	40	0.067

Table 2: Mean VAS/VISA scores before and after treatments 1 and 2.

Predictor Variables

The initial step involved evaluating potential predictors for their suitability. Each variable was examined to determine its association with the primary outcome measure (positive or negative response to treatment) and completeness (number of missing values). The full list of predictors is presented in Table 3, along with p-values and effect sizes where applicable.

Table 3: Predictive value of baseline data.

Variable	p-value	N	Effect Size (OR)
Gender (being Male)	0.676	182	
Age (per year of Age)	0.009**	183	1.038 [1.010,1.068]
Duration of symptoms (months)	0.579	176	
Athletic	0.563	63	
Insidious	0.108	61	
Insoles	0.529	99	
Bilateral symptoms (No/Yes)	0.454	117	
Side of Body (Left/Right)	0.795	183	
Location of symptoms (Body/Insertion/Both)	0.533	181	
Neovessels	0.608	137	
VAS score at baseline (per unit)	0.001**	176	0.978 [0.964,0.991]
VISA-A score at baseline (per unit)	0.002**	170	1.030 [1.010,1.049]

Among the 12 variables available, only 3 demonstrated a significant association with successful discharge and the primary outcome measure. The severity of symptoms showed a strong correlation with the probability of successful treatment; patients reporting lower pre-treatment pain (VAS) and higher VISA-A scores had an increased likelihood of discharge post-treatment. Additionally, patient age significantly impacted recovery, with older patients exhibiting a much higher chance of recovery.

Building a predictive model

An objective of the study was to construct a predictive model that was robust, easy to use and relied only on easily available data. To this end we narrowed our focus to a subset of variables.

As VAS and VISA were highly correlated, measuring very similar constructs, we felt we did not need to use both. VAS scores are considerably easier to obtain and so VISA-A was dropped from the list of predictors. Age was retained, as a highly significant predictor, although it was transformed into a binary indicator (up to 60, 60 or over) since its effect was not linear (see Figure 2). Several of the other predictors were also removed, either because they contained a high proportion of missing data (e.g. insidious) or lacked discrimination (e.g. only 1 person reported not receiving an US scan). The set of variables used for modelling contained only 6. These were gender, age over 60, VAS, side of body, duration of symptoms and location.

Model Selection

Model selection started with the full set of six predictors and proceeded through Backwards Elimination, converging to a simple, two variable model, containing only VAS and age (see Figure 3).

Model coefficients show that those experiencing greater pain (higher VAS scores) generally had a lower likelihood of discharge following treatment (p=0.009) with a 20 point increase in VAS appearing to indicate a one third reduction in the odds of discharge. Surprisingly older patients (60+) demonstrated substantially higher discharge rates than younger ones (p=0.004) and the odds of successful treatment was over three times higher for the over 60s.

Table 4: Predictive model for treatment success

Variable	p-value	Effect Size (OR)
Constant	0.127	2.082
Baseline VAS score (per unit)	0.009**	0.980 [0.966,0.995]
Age (over 60)	0.004**	3.229 [1.462, 7.132]

Heuristic for treatment pathway

In clinical practice, instead of using the logistic regression model described earlier to obtain predicted probabilities, a simple lookup table (Table 5) is provided. This table shows the predicted probability of successful treatment for each VAS score band for individuals aged up to, and over 60. To determine the probability of successful treatment, cross-reference the patient's age and VAS score. The cell will contain the predicted chance of a positive outcome.

		VAS score before treatment							
		0-19	20-29	30-39	40-49	50-59	60-69	70-79	80 and over
Age	Up to 60 years	61%	56%	51%	46%	41%	35%	32%	28%
	60 years and over	83%	80%	77%	73%	69%	64%	60%	56%

Table 5: Heuristic for predicting chance of treatment success

Stability Investigation

Heinze (2018) published guidelines for assessing robustness of regression model with small sample size. The recommendations are to use backward elimination supported by a stability investigation (16).

This approach uses resampling to determine how small changes to sample might impact the selected model. Results showed the model structure to be extremely robust. Nor was there evidence that the selection process had introduced significant bias in estimation of the parameter values, despite the limited sample size.

Discussion

This study is the first to investigate what factors are associated with positive outcomes from ESWT treatment with only pre-treatment symptoms (VAS, VISA-A) and patient age being significant contributors.

These three predictors were approximately equally informative, each accounting for between 5 and 8% of the variance in outcomes within a simple pairwise model. However, not all are equally useful in practice. VISA-A and VAS are highly correlated (rho=-0.512, p<0.001, Pearson), indicating substantial shared information. In contrast, neither correlates with age, signifying that the effect of age is independent of severity. The final predictive consisting of only VAS and patients age, with milder symptoms and older age being associated with a greater chance of success.

It is perhaps not surprising that patients presenting with the highest pain scores are less likely to achieve significant clinical improvement. The finding that older patients exhibit a higher likelihood of recovery, however, was unanticipated, as advancing age is typically linked to reduced tissue quality, decreased vascularity, diminished elasticity, and impaired healing capacity (18). Potential explanations for this association may include the lower activity demands observed in older individuals, or psychosocial and health-related quality of life factors—variables not assessed within this study—that could influence the predictive model.

Forty six percent of patients were discharged with sufficient benefit. This supports the NICE guidelines and highlights the inconsistencies in the effectiveness of ESWT for Achilles tendinopathy (3, 5, 6, 8). Automatically prescribing an intervention with such effectiveness to all patients suffering from Achilles Tendinopathy is both wasteful and inefficient. Clinical decision-making would benefit from predictive guidance. This study shows that the most suitable treatment pathway may be selecting with reference to patient characteristics.

This research methodology has certain advantages; however, there are currently no other peer-reviewed studies investigating the effects of ESWT for Achilles tendinopathy across various patient characteristics or developing predictive models. Consequently, direct comparisons with findings from other studies were not possible. Previous related work as part of TAP development evaluated the effects of eccentric

exercises (EE) on Achilles tendinopathy and established a predictive model based on patient characteristics. In that study, 34% (54 out of 158) of participants responded positively to EE, with pre-treatment severity scores (VAS and VISA-A) and exercise quality identified as the strongest predictors of outcome. Additionally, higher initial symptom severity was associated with lower rates of positive results (18).

Building and publishing the model constitutes the initial phase of the development process. The next step is model validation, which involves thorough testing to assess whether the model can accurately predict outcomes using previously unseen data. This process includes both internal and external validation to evaluate the model's generalisability across various populations. The final step is to examine the practical application of the validated model by consulting clinicians to determine its potential impact on patient outcomes and clinical utility.

Our next priority is also to examine the predictive results of the other treatments in our hierarchical TAP model, namely, physiotherapy, dry needling and surgery.

Limitations and considerations

This single-centre UK study may limit generalisability. Without a control group, observed improvements could stem from natural recovery or placebo effects. Most participants had prior treatments making it unclear if ESWT alone caused any resulting changes. Further research should examine the effects of omitting initial treatments.

Outcomes beyond 12 weeks were not investigated, so long-term effects are unknown. The predictive model uses patient data for risk estimates while aiming for clinical practicality, but balancing these goals is challenging. Variables like BMI, psychological scores, and quality of life were excluded to reduce the risk of burdening staff, though they may predict positive outcomes.

The study is limited (in terms of external validity) to the intervention parameters set (3 treatments over 3 weeks). A different number of treatments with varying or contrasting durations between treatment may result in different results. However, in terms of pragmatism, most health boards are limited by resources and some health

boards unable to offer ESWT. Notably in the health board from which this study originates funding is not available for ESWT for other tendinopathies aside from the Achilles and plantar fascia. As only ESWT alone was assessed, findings may not apply to combined therapies. Quantitative benefit data can aid policy and clinical management, reducing "trial and error." The prognostic model supports decision-making but does not replace individual patient care.

CONCLUSION

This study provides an analysis of the rate and determinants associated with positive outcomes at three months following ESWT in patients diagnosed with Achilles tendinopathy. Age and baseline symptom severity were identified as significant predictors of successful treatment response. Additionally, a predictive model was developed that may offer valuable clinical utility.

Reference:

1. Hutchison A, Beard,D,Pallister,I, Topliss,C and Williams,P. Is Physiotherapy effective for patients with a crhonic mid-body Achilles tendinopathy? A systematic review of non-surgical and non-pharmacological interventions. International Musculoskeletal Medicine. 2011;33(4):152-60.
2. Hutchison AM, Laing H, Williams P, Bodger O, Topliss C. The effects of a new Tendo-Achilles Pathway (TAP) on an orthopaedic department- A quality improvement study. Musculoskelet Sci Pract. 2019;39:67-72.
3. Extracoporeal Shockwave therapy for refractory Achilles tendinopathy [Internet]. NICE guidelines. 2009 [cited December 2010].
4. Simplicio CL, Purita J, Murrell W, Santos GS, Dos Santos RG, Lana J. Extracorporeal shock wave therapy mechanisms in musculoskeletal regenerative medicine. J Clin Orthop Trauma. 2020;11(Suppl 3):S309-S18.
5. Majidi L, Khateri S, Nikbakht N, Moradi Y, Nikoo MR. The effect of extracorporeal shock-wave therapy on pain in patients with various tendinopathies: a systematic review and meta-analysis of randomized control trials. BMC Sports Sci Med Rehabil. 2024;16(1):93.
6. Stania M, Mala J, Chmielewska D. The Efficacy of Extracorporeal Shock Wave Therapy as a Monotherapy for Achilles Tendinopathy: A Systematic Review and Meta-Analysis. J Chiropr Med. 2023;22(4):294-301.
7. Paantjens MA, Helmhout PH, Backx FJG, van Etten-Jamaludin FS, Bakker EWP. Extracorporeal Shockwave Therapy for Mid-portion and Insertional Achilles Tendinopathy: A Systematic Review of Randomized Controlled Trials. Sports Med Open. 2022;8(1):68.

8. Charles R, Fang L, Zhu R, Wang J. The effectiveness of shockwave therapy on patellar tendinopathy, Achilles tendinopathy, and plantar fasciitis: a systematic review and meta-analysis. Front Immunol. 2023;14:1193835.
9. Fan Y, Feng Z, Cao J, Fu W. Efficacy of Extracorporeal Shock Wave Therapy for Achilles Tendinopathy: A Meta-analysis. Orthop J Sports Med. 2020;8(2):2325967120903430.
10. Butler J, Zeng, D, Wals, C, Azam M, DeClouette B, Kenndy J. Paper 68: Outcomes following Extracorporeal Shockwave Therapy for chronic Achilles tendinopathy at short to mid-term follow-up. The Journal of Sports Medicine 2023;11(7).
11. Cheng JH, Jhan SW, Chen PC, Hsu SL, Wang CJ, Moya D, et al. Enhancement of hyaline cartilage and subchondral bone regeneration in a rat osteochondral defect model through focused extracorporeal shockwave therapy. Bone Joint Res. 2024;13(7):342-52.
12. Collins GS, Moons KGM, Dhiman P, Riley RD, Beam AL, Calster BV, et al. TRIPOD+AI statement: updated guidance for reporting clinical prediction models that use regression or machine learning methods: a Korean translation. Ewha Med J. 2025;48(3):e48.
13. Watson T. Electrotherapy on the web. Educational resources for practitioners, students, researchers and educators. Contraindications. Shockwave. [Webpage]. 1995-2025 [Available from: https://www.electrotherapy.org/contraindications-1.
14. Robinson JM, Cook JL, Purdam C, Visentini PJ, Ross J, Maffulli N, et al. The VISA-A questionnaire: a valid and reliable index of the clinical severity of Achilles tendinopathy. British journal of sports medicine. 2001;35(5):335-41.
15. Wewers ME, Lowe NK. A critical review of visual analogue scales in the measurement of clinical phenomena. Res Nurs Health. 1990;13(4):227-36.
16. Heinze G, Wallisch C, Dunkler D. Variable selection - A review and recommendations for the practicing statistician. Biom J. 2018;60(3):431-49.
17. Bujang MA, Sa'at N, Sidik T, Joo LC. Sample Size Guidelines for Logistic Regression from Observational Studies with Large Population: Emphasis on the Accuracy Between Statistics and Parameters Based on Real Life Clinical Data. Malays J Med Sci. 2018;25(4):122-30.

Figure 1 Study flow demonstrating the positive and negative outcomes following ESWT

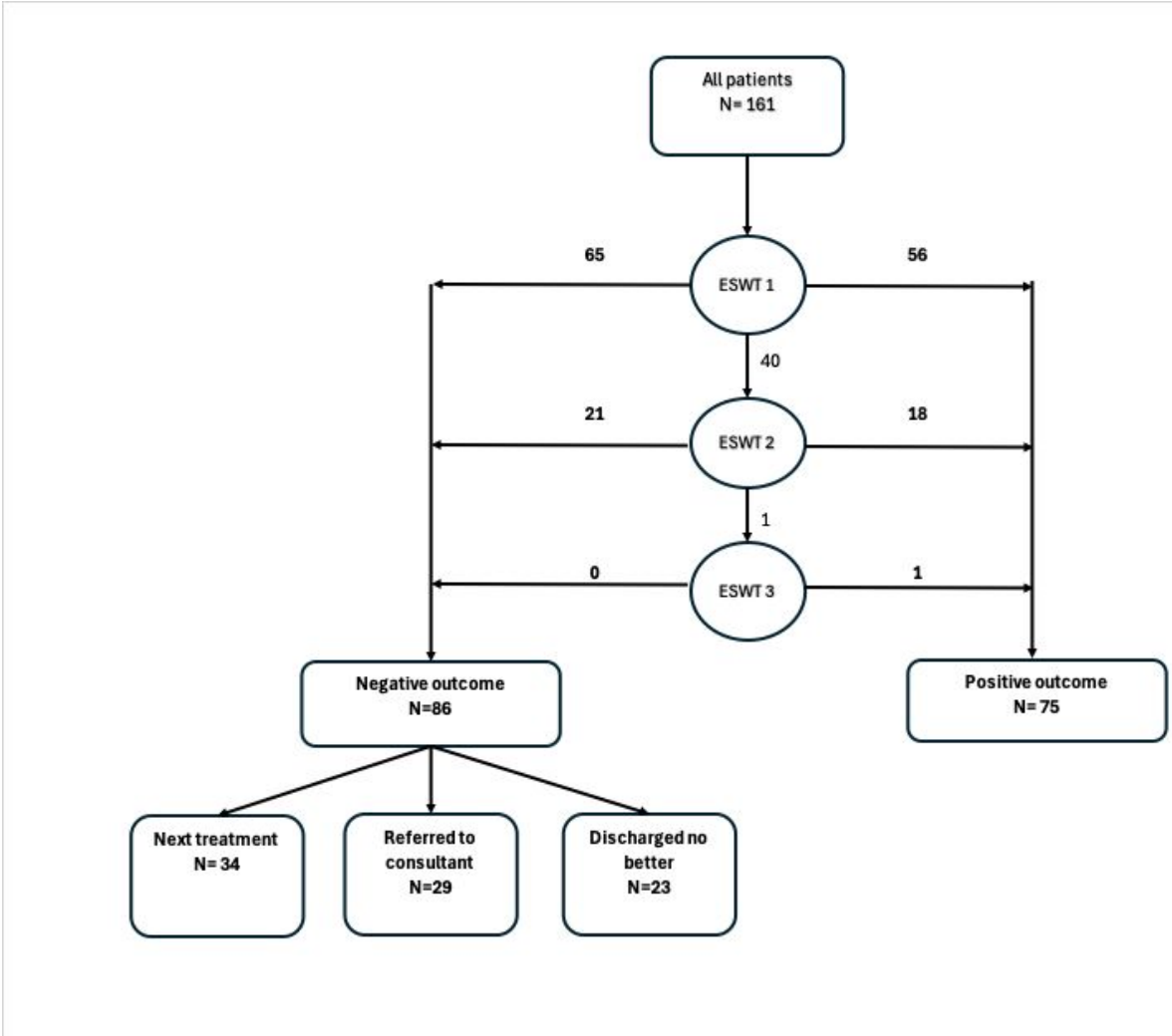

Figure 2: The association between age and treatment outcome.

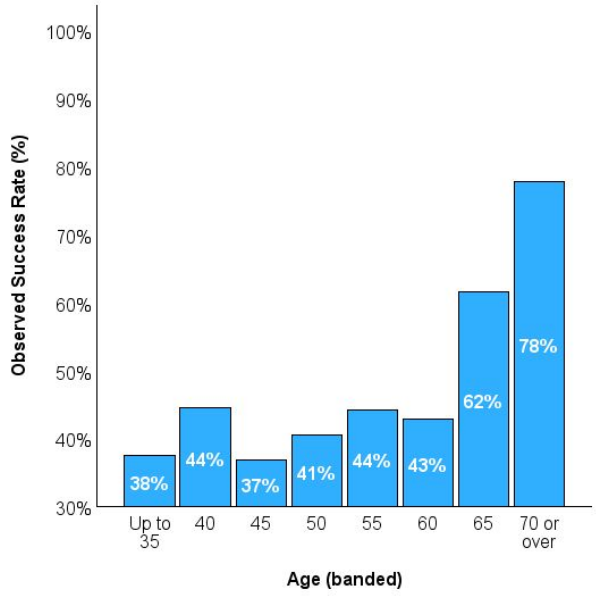

Fig 3: Observed success by age and VAS score.