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Analysing the outcome of surgery for chronic Achilles tendinopathy over the last 50 years

Wasim S Khan, Seema Malvankar, Jagmeet S Bhamra, Ioannis Pengas

Wasim S Khan, Seema Malvankar, Jagmeet S Bhamra, Ioannis Pengas, University College London Institute of Orthopaedics and Musculoskeletal Science, Royal National Orthopaedic Hospital, Stanmore, Middlesex, London HA7 4LP, United Kingdom

Author contributions: Khan WS and Malvankar S analysed the literature; Malvankar S wrote the preliminary draft of the manuscript and Khan WS revised the paper; Bhamra JS and Pengas I supervised the project and critically reviewed the draft; all authors approved the final submitted version of the manuscript.

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Correspondence to: Dr. Wasim S Khan, Clinical Lecturer, University College London Institute of Orthopaedics and Musculoskeletal Science, Royal National Orthopaedic Hospital, Brockley Hill, Stanmore, Middlesex, London HA7 4LP, United Kingdom. wasimkhan@doctors.org.uk
Telephone: +44-79-71190720
Fax: +44-20-85703864

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Abstract

AIM: To determine an association between when the study was performed, the robustness of the study and the outcomes for insertional and non-insertional Achilles tendinopathy surgery.

METHODS: We performed a systematic review in accordance with the PRISMA guidelines to assess the methodology of studies investigating the outcome of surgery in chronic Achilles tendinopathy over the last 50 years to identify any trends that would account for the variable results. The Coleman Methodology Scores were correlated with the reported percentage success rates and with the publication year to determine any trends using Pearson's correlation.

RESULTS: We identified 62 studies published between 1964 and 2014 reporting on a total of 2923 surgically treated Achilles tendinopathies. The average follow-up time was 40 mo (range 5-204 mo), and the mean reported success rate was 83.5% (range 36%-100%). The Coleman Methodology Scores were highly reproducible (r = 0.99, P < 0.01), with a mean of 40.1 (SD 18.9, range 2-79). We found a negative correlation between reported success rate and overall methodology scores (r = -0.40, P < 0.001), and a positive correlation between year of publication and overall methodology scores (r = 0.46, P < 0.001).

CONCLUSION: We conclude that although the success rate of surgery for chronic Acilles tendinopathy described in the literature has fallen over the last 50 years, this is probably due to a more rigorous methodology of the studies.

Key words: Achilles tendon; Surgery; Methodology; Outcome; Tendinopathy

Core tip: Although the success rate of surgery for chronic Acilles tendinopathy described in the literature has fallen over the last 50 years, this is probably due to a more rigorous methodology of the studies. Future studies with more robust methodologies will hopefully address some of the unanswered questions in the surgical management of this difficult condition.

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INTRODUCTION

Overuse injuries of the Achilles tendon are becoming increasingly common. Its manifestation used to be more associated with male athletes[1], however the rise in the incidence of Achilles tendon disorders is considered to be due to more females participating in recreational and competitive sporting activities[1]. Even though injuries of the Achilles tendon are on the rise, little is known regarding the long-term outcome of their surgical management due to a lack of reliable outcome studies[2]. Subjectively there is evidence that the surgical outcomes reported in the literature are worse than those described historically[3].

In addition to the lack of reliable research on the management of insertional and non-insertional Achilles tendinopathy, there is also a poor understanding of its pathogenesis, and its aetiology is unknown[4]. Even though Achilles tendinopathy has been linked to overuse, one study found that 31% of 58 patients who had Achilles tendinopathy did not participate in vigorous activity[5]. Other suggested Achilles tendinopathy caused by a mixture of intrinsic and extrinsic factors such as poor vascularity, genetic make-up, quinolone antibiotics, change of training regime or a change of foot wear[5]. The term "tendinitis" is incorrect as Achilles tendinopathy is not an inflammatory reaction[6]. Puddu *et al*[7] stated that "tendinosis" is a better term as this describes the collagen degeneration that occurs in tendinopathy, however this can only be conclusively demonstrated after histopathological confirmation[7]. Puddu *et al*[7] also further classified Achilles tendon disease based on his histological findings into peritendinitis and tendinosis, that could coexist and also develop into each other[7]. We therefore advocate the use of the term "tendinopathy" as a generic descriptor of the clinical conditions in and around tendons arising from overuse, eliminating the need for histopathological confirmation[3].

The lack of understanding of this condition and the poor use of terminology leave many questions to be answered, regarding the management of Achilles tendinopathy[3]. It has been stated generally that conservative treatment is not successful for patients with chronic Achilles tendinopathy and that surgical intervention is needed for 25% of patients[4]. Research has showed that the historical short-term results of surgical treatment are frequently very good but these studies are generally unreliable and fail to record the long term outcome of surgical management[4].

We therefore performed a systematic review of the available published literature over the last 50 years to analyse the studies and identify any explanations for these observations.

MATERIALS AND METHODS

This review was carried out following Institutional Review Board approval in accordance to PRISMA guidelines to analyse the quality of studies investigating the outcome of surgery for chronic Achilles tendinopathy from 1964-2014. The eligibility criterion for this systematic review was any study that investigated the surgical outcome for Achilles tendinopathy as its primary goal and that had its full text available in the English language. The eligibility criteria were not limiting as the aim of this study was to critically analyse the quality of the methodologies. A MEDLINE search covering the years 1964 to 2014 was performed. The search was first carried out on 10 September 2014 and the date last searched was 28 January 2015. Keywords used in the search were "Achilles tendon", "tendinitis", "tendon", "surgery", "postoperative complications", "tendon injuries" and "tendinopathy". All journals were considered and all relevant articles were retrieved. A hand search was also conducted and all relevant articles were also included in the study. The study selection process involved screening the study titles to check their relevance to Achilles tendinopathy, and then subsequently their abstracts were screened to check that the primary goal of each included study was investigating the surgical outcome of chronic Achilles tendinopathy. Studies that investigated the surgical outcome of Achilles tendon ruptures were excluded as even though these can develop as a result of chronic Achilles tendinopathy, this is not always the case and ruptures are Achilles tendinopathy, this is not always the case and ruptures are appropriately a separate medical condition in itself. The data collection involved examining all the studies for their reported surgical outcomes. We used the functional classification described by Nelen *et al*[8] (Table 1) to compare the outcome of the studies. We defined "success rate" as the sum of excellent and good outcomes expressed as a percentage of the total outcomes. A methods assessment for risk of bias in individual studies was carried out by using the criteria developed by Coleman *et al*[9] (Table 2) to blindly assess the methods of each article twice. Where previous Coleman Methodology Scores were available for studies in the literature, the scores were checked to ensure

Table 1 Functional classification of postsurgical outcome for Achilles tendinopathy[8]

Rating	Result
Excellent	No residual symptoms, sports performance unlimited
Good	Full return to the same sport as preoperatively; some stiffness after strenuous activities
Fair	Improvement with regard to the preoperative situation; still stiffness and aching relating to sports
Poor	No improvement at all

Table 2 Coleman Methodology Score criteria for studies reporting the outcomes of surgery for Achilles tendinopathy[9]

Section	Number or factor	Score
Part A - only one score to be given for each of the seven sections		
Study size - number of tendons (N) (if multiple follow-up, multiply N by number of times subjects followed up)	> 60	10
	41-60	7
	20-40	4
	< 20, not stated	0
Mean follow-up (mo)	> 24	5
	12-24	2
	< 12, not stated, or unclear	0
Number of different surgical procedures included in each reported outcome. More than one surgical technique may be assessed but separate outcomes should be reported	One surgical procedure only	10
	More than one surgical procedure, but > 90% of subjects undergoing the one procedure	7
	Not stated, unclear, or < 90% of subjects undergoing the one procedure	0
Type of study	Randomized control trial	15
	Prospective cohort study	10
	Retrospective cohort study	0
Diagnostic certainty (use of preoperative ultrasound, MRI, or postoperative histopathology to confirm diagnosis)	In all	5
	In > 80%	3
	In < 80%, not stated, or unclear	0
Description of surgical procedure given	Adequate (technique stated and necessary details of that type of procedure given)	5
	Fair (technique only stated without elaboration)	3
	Inadequate, not stated, or unclear	0
Description of postoperative rehabilitation	Well described with > 80% of patients complying	10
	Well described with 60%-80% of patients complying	5
	Protocol not reported or < 60%-80% of patients complying	0
Part B - scores may be given for each option in each of the three sections if applicable		
Outcome criteria (if outcome criteria is vague and does not specify subjects' sporting capacity, score is automatically 0 for this section)	Outcome measures clearly defined	2
	Timing of outcome assessment clearly stated (*e.g.*, at best outcome after surgery or at follow-up)	2
	Use of outcome criteria that has reported good reliability	3
	Use of outcome with good sensitivity	3
Procedure for assessing outcomes	Subjects recruited (results not taken from surgeons' file)	5
	Investigator independent of surgeon	4
	Written assessment	3
	Completion of assessment by subjects themselves with minimal investigator assistance	3
Description of subject selection process	Selection criteria reported and unbiased	5
	Recruitment rate reported: > 80% or < 80%	5
	Eligible subjects not included in the study satisfactorily accounted for or 100% recruitment	5

they corresponded. Each study was given a Coleman Methodology Score of between 0 and 100 after scoring for 10 criteria. The Coleman Methodology Scores were correlated with the reported percentage success rates and with the publication year to determine any trends using Pearson's correlation (r). A statistical review of the study was performed by a biomedical statistician.

RESULTS

We identified 62[2,4-6,8,10-66] studies published between 1964 and 2014 reporting on a total of 2923 surgically treated Achilles tendinopathies. The average follow-up time was 40 mo (range 5-204 mo), and the mean reported success rate was 83.5% (range 36%-100%). The mean Coleman Methodology Scores for each of the 10 criteria for the included studies are summarised in Table 3. The methodology of each study was blindly assessed twice, and the Coleman Methodology Scores were highly reproducible (r = 0.99, P < 0.01), with a mean of 40.1 (SD 18.9, range 2-79). The Coleman Methodology Scores for the individual studies are shown in Table 4. The Table also includes data on year of publication, mean follow-up period, number of tendons and percentage success.

The Coleman Methodology Scores were correlated with the reported success rate and year of publication to determine any trends. For the 62 studies, the

Table 3 Mean Scores for each of the 10 Coleman Methodology Score criteria for all included studies

Methodology criteria (maximum score)	Mean		Range
	Score	SD	
Part A			
Study size (10)	4.5	4.6	0-10
Follow-up (10)	3.3	2.4	0-5
No. of procedures (10)	6.6	5	0-10
Type of study (15)	3.4	5.4	0-10
Diagnostic certainty (5)	1.9	2.5	0-5
Description of surgical technique (5)	4.1	1.8	0-5
Rehabilitation and compliance (10)	4.8	5	0-10
Part B			
Outcome criteria (10)	4.7	3.7	0-10
Outcome assessment (15)	5.2	4.5	0-12
Selection process (15)	4.6	6	0-15
Methodology score (100)	40.1	18.9	2-79

methodology score negatively correlated with the reported success rate (r = -0.40, P < 0.001) suggesting that studies with lower methodology scores reported higher success rates (Figure 1). The methodology score positively correlated with the year of publication (r = 0.46, P < 0.001) suggesting that methodology has improved over the past 50 years (Figure 2).

DISCUSSION

Our review identified 62 studies investigating almost 3000 tendons followed up for almost 40 mo published over the last 50 years that looked at surgical outcome of Achilles tendinopathy. The studies included in our review reported a mean success rate of 84% (SD 14%). The studies had a mean Coleman Methodology Score of 40 (SD 19). Our results identified trends in Coleman Methodology Score with the year of publication and the success rate. It was interesting to note that as the Coleman Methodology Scores improve, the success rate of studies falls. This is likely to be due to the fact that more robust studies with a higher methodology score are more objective in assessing outcome and are associated with less bias. The Coleman Methodology Score is produced by assessing two parts and the more robust studies scored well in both of these. The first part scored higher for a robust high quality studies with a larger number of patients with diagnostic certainty, longer follow-ups, and describing only one surgical procedure. These studies described the surgical procedure and post-operative rehabilitation regime well. Studies that did not score well included retrospective studies with fewer patients, with poorer diagnostic certainty, shorter follow-up, and possibly describing more than one procedure. These factors although describe poor methodology, do lend them to a higher success rate. Retrospective short-term studies are associated with recall bias and are known to produce a higher success rate that randomised controlled trials with long-term follow-up. The second part scored higher for well-defined patient recruitment, valid outcome criteria and independent assessment. Studies that did not score well included poor reporting of patient recruitment, unreliable outcome measures and where there was greater

Table 4 Coleman Methodology Scores for all included studies

Ref.	Year of study	Mean follow-up (mo)	N Tendons	% Success	Coleman Methodology Scores
Snook[10]	1972		4		3
Burry and Pool[11]	1973		5		2
Clancy *et al*[12]	1976		5		5
Denstad and Roaas[13]	1979		58		46
Gould and Korson[14]	1980	12			8
Kvist and Kvist[15]	1980		201	97	35
Leach *et al*[16]	1981		20		10
Subotnick and Sisney[17]	1986		42		15
Saillant *et al*[18]	1987	42	65	86	36
Schepsis and Leach[19]	1987	36	45	87	44
Nelen *et al*[8]	1989		143	67	41
Leppilahti *et al*[20]	1991		150	86	12
Anderson *et al*[21]	1992	52	48	94	27
Clement *et al*[22]	1992	69	14		13
Leach *et al*[23]	1992		12	85	8
Leppilahti *et al*[24]	1994	48	275	73	50
Schepsis *et al*[25]	1994		79	79	66
Aström and Rausing[26]	1995		163		43
Alfredson *et al*[6]	1996	12	13		60
Johnston *et al*[27]	1997	24	41		22
Maffulli *et al*[28]	1997	22	52	71	70
Morberg *et al*[29]	1997	72	64	67	74
Rolf and Movin[5]	1997	25	60	75	69
Alfredson *et al*[30]	1998	12	11		59
Maffulli *et al*[31]	1999	35	14	36	56
Paavola *et al*[32]	2000	5	142		59
Wilcox *et al*[33]	2000	14	20		32
Ohberg *et al*[34]	2001	60	24	92	65
Shalabi *et al*[35]	2001	24	15	87	51
Maquirriain *et al*[36]	2002	16	7		37
Paavola *et al*[37]	2002	7	42		46
Shalabi *et al*[38]	2002	24	15	80	51
Yodlowski *et al*[39]	2002	39	41		39
Chiara Vulpiani *et al*[40]	2003	156	86	88	35
Den Hartog *et al*[41]	2003	35	29	88	34
Saxena[42]	2003	56	37	100	17
Martin *et al*[43]	2005	41	44		52
Costa *et al*[44]	2006	90	21		27
Johnson *et al*[45]	2006	34	22		32
Maffulli *et al*[46]	2006	37	93	81	74
Wagner *et al*[47]	2006	40	81		29
Alfredson *et al*[2]	2007	6	20		61
Cottom *et al*[48]	2008	27	62	95	37
Hahn *et al*[49]	2008	46	13		38
Maffulli et al[50]	2008	40	86	73	79
Vega *et al*[51]	2008	24	8	100	51
Bohu *et al*[52]	2009	42	137		29
Thermann *et al*[53]	2009	6	8		37
Will *et al*[54]	2009	22	19		34
Duthon *et al*[55]	2011	24	17	79	48
van Sterkenburg *et al*[56]	2011	12	3	100	44
Maffulli *et al*[57]	2011	36	30	85	54
Sarimo *et al*[58]	2011	30	24	100	42
Oshri *et al*[59]	2012		21	62	43
Kiewiet *et al*[60]	2013	35	12		30
Maffulli *et al*[61]	2013	204	39	77	42
Maquirriain[62]	2013	92	27	96	47
Benazzo *et al*[63]	2014	48	52		60
Tallerico *et al*[64]	2014	14	11		28
Maffulli *et al*[65]	2015	54	18	100	38
Nawoczenski *et al*[66]	2015	18	13	85	52

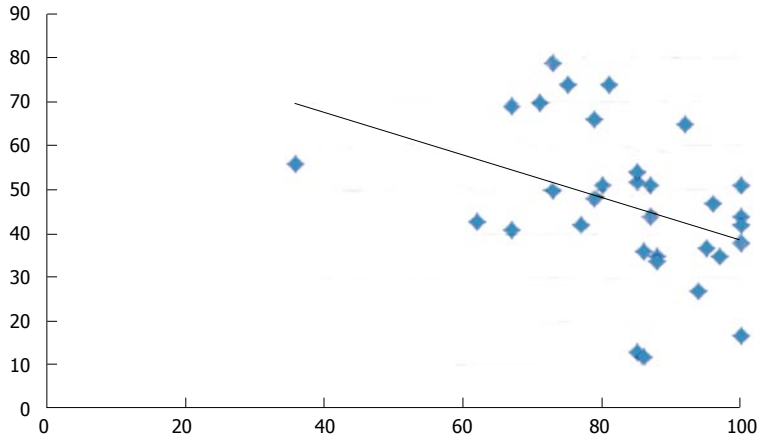

Figure 1 Relationship between Coleman Methodology Score (Y-axis) and reported percentage success rate (X-axis) showing a negative correlation.

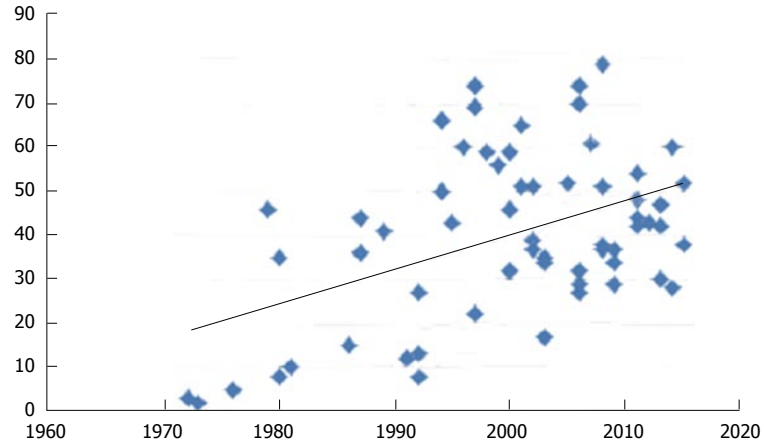

Figure 2 Relationship between Coleman Methodology Score (Y-axis) and year of publication (X-axis) showing a positive correlation.

investigator assistance in completing assessment. Again, these factors would contribute to a higher success rate. Over the past 50 years we have shown that the Coleman Methodology Scores has been increasing. There was a shift from retrospective to prospective studies. Over the last 50 years the number of journals and publications has increased, but this is associated with an increase in the quality of studies. Historically, most studies were retrospective studies reporting short-term follow-up for a small number of patients. More recent studies have included randomised controlled trials that recruit a large number of patients and report longer follow-ups. More recent studies are also more likely to confirm the diagnosis radiologically before instigating treatment, and describe the surgical procedure and post-operative rehabilitation regime well. We suggest future studies to continue to use a robust methodology. This should include multi-centre randomised controlled trials using a large number of patients with long-term follow-up where possible. It is important to have well-defined inclusion and exclusion criteria. These studies should have a uniform pre-operative, operative and post-operative rehabilitation course, with a greater degree of diagnostic certainty. They should be free from selection bias and results bias by describing the selection process and having a good follow-uprate. It is important to use a valid, reliable and responsive outcome measure that is free from bias. Blinding and independence of the investigator is useful. These studies are however associated with greater costs. We hope that poorer success rates that are associated with better methodology do not result in publication bias.

COMMENTS

Background

Insertional and non-insertional Achilles tendinopathy is a difficult problem to manage and surgery is performed when non-operative treatmentoptions fail.

Research frontiers

Studies for insertional and non-insertional Achilles tendinopathy surgery describe a variable outcome in the literature. Future studies need to use a more robust methodology.

Innovations and breakthroughs

The authors performed a systematic review in accordance with the PRISMA guidelines to assess the methodology of studies investigating the outcome of surgery in chronic Achilles tendinopathy over the last 50 years to identify any trends that would account for the variable results. The Coleman Methodology Scores were correlated with the reported percentage success rates and with the publication year to determine any trends using Pearson's correlation. The authors found a negative correlation between reported success rate and overall methodology scores (r = -0.40, P < 0.001), and a positive correlation between year of publication and overall methodology scores (r = 0.46, P < 0.001). The authors conclude that although the success rate of surgery for chronic Acilles tendinopathy described in the literature has fallen over the last 50 years, this is probably due to a more rigorous methodology of the studies.

Applications

Although the success rate of surgery for chronic Acilles tendinopathy described

in the literature has fallen over the last 50 years, this is probably due to a more rigorous methodology of the studies. Future studies with more robust methodologies will hopefully address some of the unanswered questions in the surgical management of this difficult condition.

Terminology

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) is an evidence-based minimum set of items for reporting in systematic reviews and meta-analysis.

Peer-review

This work proposes an extensive review on Achilles tendinopathy over the last 50 years. There are merits in this study because it may give some cues for future researches and clinical application in Achilles tendinopathy. As such, the theme is of interest.

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