The Effects of a Standard Postoperative Rehabilitation Protocol for Arthroscopic Rotator Cuff Repair on Pain, Function, and Health Perception

Roberta Monesi[1] Maria Grazia Benedetti[1] Alessandro Zati[1] Daniela Vigna[1] Domenico Romanello[1] Alberto Monello[1] Roberto Rotini[2]

[1] Physical Medicine and Rehabilitation Unit, IRCCS-Istituto Ortopedico Rizzoli, Bologna, Italy
[2] Division of Shoulder and Elbow Orthopedic, IRCCS-Istituto Ortopedico Rizzoli, Bologna, Italy

Address for correspondence Maria Grazia Benedetti, MD, Physical Medicine and Rehabilitation Unit, IRCCS-Istituto Ortopedico Rizzoli, Via Pupilli 1, 40124 Bologna, Italy (e-mail: benedetti@ior.it).

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Abstract

Purpose There is still conflicting evidence to support postoperative rehabilitation protocols using immobilization following rotator cuff repair over early motion. The objective of the study was to evaluate the evolution of pain, shoulder function, and patients' perception of their health status up to 1 year after cuff rotator repair and a standard postoperative rehabilitation protocol consisting of 4 weeks of immobilization followed by a 2-week assisted controlled rehabilitation.

Methods Descriptive, longitudinal, uncontrolled case-series study was performed on 49 patients who underwent arthroscopic rotator cuff repair following traumatic or degenerative lesions. VAS scale for pain, Constant–Murley score for function, and SF-12 score for quality of life were used as outcome measures and were administered before the rehabilitation treatment, at the end of the 2-week rehabilitation, 3 months, and 1 year after surgery.

Results VAS pain score decreased significantly along the follow-up reaching almost a nil value after 1 year (0.2). Function as measured by Constant–Murley score had a significant improvement during follow-up, reaching a mean value of 84.6. The short form (SF)-12 score increased over time reaching 46.3 for the physical and 43.8 for the psychological dimension, respectively, at 1 year.

Conclusion The present study confirmed an excellent outcome at 1 year after rotator cuff repair using a traditional 4-week immobilization followed by a 2-week rehabilitation protocol without evidence of tendon un-healing or re-tearing.

Level of Evidence This is a level IV, therapeutic case series.

Keywords
- pain
- rotator cuff
- repair
- arthroscopy
- rehabilitation

Introduction

Rotator cuff tears, either traumatic or degenerative, can cause joint limitation and pain that hamper daily activities and sleep quality. When a conservative treatment for a damaged rotator cuff fails, there is the indication for repair. Owing to the recent evolution of surgical techniques, arthroscopic repair presents several potential advantages compared with the open approach.[1,2]

Postoperative rehabilitation timeline is quite debated.[2–7] While some authors suggest to avoid active shoulder movements for up to approximately 6 to 8 weeks to allow tendon-to-bone healing, others claim the need to counteract the negative impacts of long time immobilization.[8,9] Tendon healing

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requires fixation techniques that provide adequate initial strength, stability, and compression against the rotator cuff footprint, while maximizing the biologic factors that allow ultimate tendon-to-bone healing.[9] The effectiveness of an early protected or unprotected motion or a sling immobilization regimen in the first 4 weeks after surgery has been reviewed without reaching a uniform recommendation.[2] Notwithstanding the tremendous variability in postoperative rehabilitation protocols after rotator cuff repair,[10] a consensus seems to converge on initiating passive shoulder range of motion (ROM) exercises after 2 weeks with a staged introduction of protected passive ROM followed by active ROM at 6 weeks.[2] However, timing depends on tears dimensions, tissue quality, surgical fixation, age, and general status of patients.[7] Physiotherapy should guarantee adequate tendon healing, cuff flexibility, as well as prevent contractures and joint rigidity with the aim of increasing ROM on all planes, muscle strength, and the proprioceptive control of the glenohumeral joint. Pain is often the main problem to be addressed after surgery.[11] Pain scoring by the visual analogic scale (VAS) has been reported to reach up to 9 points at 6 weeks after surgery.[12] Pain is a subjective physical and emotional experience that acts as a defense mechanism; therefore, the most common consequence of this condition is the immobilization of the affected shoulder. The physiotherapist must thus compromise between achieving a progressive increase in function in the operated shoulder and controlling pain.

Based on these considerations, the purpose of the present study was to evaluate the evolution of pain, shoulder function and patients' perception of their health status up to 1 year after rotator cuff repair and a standard rehabilitation protocol consisting of 4-week immobilization followed by a 2-week assisted controlled rehabilitation. The hypothesis of the study was that standard postoperative rehabilitation protocol for arthroscopic rotator cuff repair achieves a satisfactory outcome in terms of pain, function and subjective assessment.

Methods

Study Design

This is a descriptive, longitudinal, uncontrolled case-series study on patients who underwent arthroscopic repair of traumatic or degenerative rotator cuff tears. The study was approved by the Ethics Committee of our Institute (n. 0013483), and all patients signed an informed consent form.

Participants

Patients were selected among those attending the hospital outpatient rehabilitation facility after arthroscopic rotator cuff repair over 1 year. Patients with degenerative or traumatic rotator cuff tears requiring arthroscopic repair who accepted to adhere to the study were included into the study. Exclusion criteria were as follows: acute sport injuries; cognitive deficits; contraindications to electrotherapy; cardiovascular, rheumatic, neurological or neoplastic comorbidities; previous shoulder surgery, or concomitant humerus fractures, or shoulder dislocation.

Patients eligible to enter the study were enrolled by the physiatrist at the time of rehabilitation starting. Out of 114 patients attending the rehabilitation facility in the study lifespan, 70 patients were eligible. Of these, 49 completed the 1-year study. The group included 19 female and 30 male patients with mean age of 59.5 ± 8.1 years. Twenty-one patients presented a traumatic (on chronic) lesion and 28 a degenerative (chronic) lesion. Twenty-nine patients had supraspinatus tendon repair; 18 patients had supraspinatus plus infraspinatus or subscapularis tendon repair, and 2 had repair of all three tendons. Thirty-seven patients had the subdeltoid bursa removed, and 47 had the biceps long head resected.

Interventions

All patients underwent the same surgical and anesthetic procedure as follows: patients were positioned in beach chair position under blended anesthesia (general and locoregional). Repairable tendons were reinserted to the greater tuberosity with metallic 5.5-mm suture anchors and high-resistance permanent braided sutures (tendon-to-bone technique). In case of irreparable cuff tears, the lesions were reduced in size with side-to-side sutures (tendon-to-tendon technique) and were reinserted to bone at its anterior and posterior margins with metallic anchors as previously described. The long head of the biceps (LHB) was resected when degenerated and/or unstable.

After surgery, the shoulder had been kept immobilized for 4 weeks with a brace in 45-degree-abduction position. Four weeks postoperatively, patients were referred to the rehabilitation facility of the authors' institute to start a supervised rehabilitation period of 2 weeks, 5 days a week. All patients were treated by the same physiotherapists with a standard rehabilitation program[13] including electrostimulation on deltoid, supraspinatus and infraspinatus muscles, continuous mechanical passive (CMP) movement on the operated shoulder in abduction and flexion position (up to 90 degrees) for 30 minutes per day; anti-scarring massage; blade massage of upper limb, cervical region, and shoulder; passive manual (first week) and assisted-active (second week) ROM exercises; glenohumeral cuff decoaptation exercises; active elbow, wrist, and hand ROM exercises; and proprioceptive exercises of the upper limb. Particular attention was paid to the scapulothoracic dyskinesia with adequate exercises.

In case of episodic pain reaching a value greater than 5 in the VAS scale during the supervised rehabilitation period, the use of ketoprofene (50 mg per os) was allowed up to three times a week.

After the supervised rehabilitation period, patients were instructed to continue their exercises at home or in an outpatient clinic with or without the supervision of a physiotherapist for active ROM and muscle strengthening exercises.

Outcome Measures

The primary outcome of the study was the evolution of pain measured by the VAS scale (0–10).[14] Pain was measured at rest. Secondary outcomes were function and mobility of the

shoulder, measured by the Constant–Murley score[15] and quality of life measured by the SF-12 score[16] using both physical component summary (PCS) and mental component summary (MCS) items. All evaluations were performed before the rehabilitation treatment (T0), at the end of the 2-week rehabilitation (T1), 3 months (T2), and 1 year (T3) after surgery.

Outcome measures were correlated with the etiology of the tear (traumatic or degenerative), gender and some surgical-related factors, such as number of tendons reinserted, partial or total coverage of the humeral head, bursectomy, and resection of the LHB. Re-tears were also recorded.

Statistical Analysis

Data analysis was performed using the SAS/STAT (SAS Institute Inc., Cary, North Carolina, United States) statistical software.

All continuous variables were expressed as mean ± standard deviation (SD). Repeated measures analysis of variance (ANOVA) with Sidak post hoc pairwise test was used to explore changes in each variable along the follow-up. The one-way ANOVA test was performed to assess differences between groups for continuous, normally distributed, and homoscedastic data. The Mann–Whitney *U*-test was used otherwise. Mann–Whitney calculated with the exact method for small samples was used to explore differences according to the number of tendons reinserted, partial or total coverage of the humeral head, bursectomy, and LHB resection at 1 year. Pearson's correlation was used to explore possible correlation of outcome measures with age. Significance was considered significant for $p < 0.05$.

Results

No correlation was found between the outcomes and the number of tendons repaired, partial or total coverage of the humeral head, bursectomy, and LHB resection. No re-tears were diagnosed during the follow-up.

Pain at rest was relatively low at T0 and decreased significantly at the subsequent follow-ups reaching almost a nil value after 1 year (T3) (►**Table 1**, ►**Fig. 1**). Pain at rest did not have any correlation with patients' age and etiology of the tear. No difference was found between traumatic or degenerative etiology (►**Table 2**). No rescue therapy for episodic pain was used by patients during the 2-week supervised rehabilitation.

As far as gender is concerned, female patients appeared to have significantly higher T0 value compared with male patients. This difference was reduced at the end of the rehabilitation period (T1), while it significantly increased again at 3-month follow-up (T2). At 1-year follow-up (T3), pain decreased equally in male and female patients (►**Table 3**).

The Constant–Murley score increased steadily and significantly over time (►**Table 1**, ►**Fig. 2**). While this improvement was not correlated with age, it showed differences in term of lesion etiology. The difference between after and

Table 1 Outcome measures along the follow-up (49 pts)

	T0	T1	T2	T3	ANOVA	Sidak post hoc pairwise test					
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	*p*-Value	T1–T0	T2–T0	T3–T0	T2–T1	T3–T1	T3–T2
VAS	1.7 (1.9)	1.4 (1.1)	1 (1.3)	0.2 (0.6)	<0.0005	= 0.547	= 0.025	<0.0005	= 0.28	<0.0005	<0.0005
Constant–Murley	21.5 (9.5)	42.9 (14.5)	57.9 (20.9)	84.6 (16.5)	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
SF 12-PCS	39.0 (8.9)	41.3 (8.2)	42.7 (6.5)	46.3 (6.3)	<0.0005	= 0.097	= 0.014	<0.0005	= 0.688	= 0.008	= 0.02
SF 12-MCS	36.0 (9.3)	37.3 (9.0)	39.6 (9.1)	43.8 (8.2)	<0.0005	= 0.641	= 0.03	<0.0005	= 0.641	= 0.001	= 0.061

Abbreviations: ANOVA, analysis of variance; MCS, mental health composite; PCS, physical component summary; pts, patients; SD, standard deviation; SF, short form; VAS, visual analog scale.

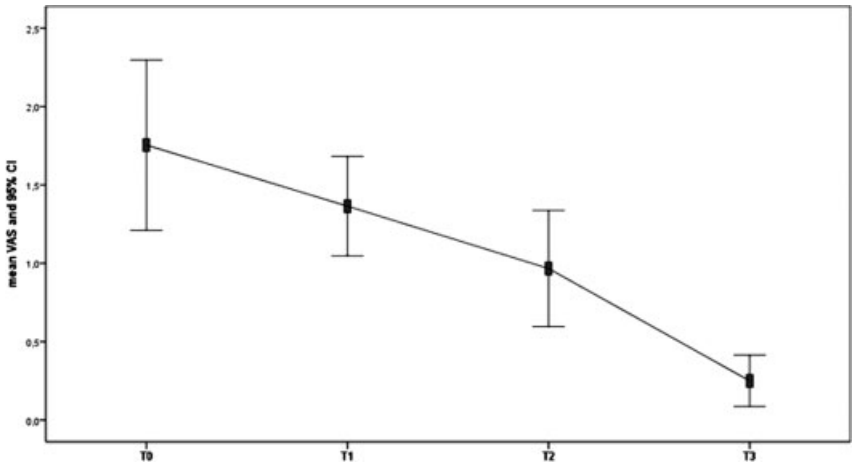

Fig. 1 VAS pain score as mean and 95% confidence interval along the follow-up. CI, confidence interval; VAS, visual analog scale.

before rehabilitation (T1–T0) was significantly greater in the degenerative tears in comparison with traumatic ones (►**Table 2**). Such difference was significant also at 3-month follow-up (T2), while at 1-year follow-up, the two groups had an almost identical score. Finally, the Constant–Murley score showed no differences between male and female patients (►**Table 3**).

The SF-12 score, both in the physical and the psychological dimension, increased significantly over time ($p < 0.0005$) (►**Table 1**, ►**Fig. 3**). The improvement in PCS was not evident at the end of the rehabilitation period, while at both T2 and at T3, there was a significant further improvement. The same trend was observed for MCS (►**Fig. 4**). There were no significant differences between the two groups in terms of etiology (►**Table 2**). Taking gender into account, lower mean scores for MCS in women were found at time T0 that were still present at T1 and T2, while at 1-year follow-up (T3), the difference was no longer strongly significant. PCS value was slightly lower in women compared with men at T0 and at T3, but this difference was not significant when considering delta (►**Table 3**). Furthermore, MCS seemed to be correlated also with age; in fact, the improvement at T2 compared with T0 decreased with age ($p = 0.036$).

Discussion

Literature reviews on functional and clinical outcomes after rotator cuff repair are not conclusive. Differences in outcome measures, follow-up duration, rehabilitation protocols, and injury patterns make any comparison very difficult. Postoperative rehabilitation protocols may vary in terms of timing, intensity, duration of immobilization, and time of return to working status, definitively dividing in accelerated and traditional protocols.[17]

In the present study, a traditional rehabilitation protocol was performed, allowing patients to remove the brace only for personal care for 4 weeks and then starting an intensive supervised rehabilitation program for 2 weeks. After this period, patients continued rehabilitation in different settings (home, aquatic, and outpatient clinic). A follow-up of 1 year was considered adequate to evaluate the results of the proposed protocol.

Several studies reported that delayed motion have benefits for clinical outcome with minor risk of shoulder stiffness, while early accelerated rehabilitation can be detrimental to the biological healing.[18] A recent review[19] compared aggressive and traditional postoperative rehabilitation and concluded that, although aggressive protocols result in more improvement in ROM and shoulder function, it entails a higher rate of tendon un-healing or re-tearing.

Results in the present study confirmed optimal outcomes at 1 year after surgery in terms of pain, function, and health perception with a standard rehabilitation protocol.

Pain at rest detected at the beginning of rehabilitation treatment after brace removal was relatively mild, confirming data from other studies.[8,20] Conversely, pain score at 3 months was considerably lower than the value of reported by Garofalo et al[12] 2.5 months after surgery, and more recently by Jeong et al[10] at 2 years postoperatively. Also, at 1-year follow-up, pain, reported in the present study was definitively less than values reported in other studies[3,14,21] and was similar to the findings of Klintberg et al.[22] In the present study, pain was measured only at rest, and no measure of pain during activity or at night was recorded. Pain during activity has a large impact on daily life activity, and it has been reported that an accelerated rehabilitation protocol provides earlier and better results on it.[23] However, in the present study, patients achieved a clinically important improvement in their pain levels with a more protective rehabilitation protocol.[24]

Function as measured by Constant–Murley score had a significant improvement during follow-up, reaching a mean value of 84.6, which is greater than that most of literature data reported at 1-year follow-up, both with traditional and accelerated rehabilitation protocols.[10,18,21,22,25–27]

Patients perceived their health status as still limited both from the physical and the mental point of view. Although PCS score remained below the reference value, matched for age,

Table 2 Differences of outcome measures with respect to etiology of the lesion

	VAS Mean (SD)		*p*-Value	Constant–Murley Mean (SD)		*p*-Value	SF-12—PCS *Mean (SD)*		*p*-Value	SF-12—MCS *Mean (SD)*		*p*-Value
	Degenerative ($n = 28$)	Traumatic on degenerative ($n = 21$)		Degenerative ($n = 28$)	Traumatic on degenerative ($n = 21$)		Degenerative ($n = 28$)	Traumatic on degenerative ($n = 21$)		Degenerative ($n = 28$)	Traumatic on degenerative ($n = 21$)	
T0	2 (1.9)	1.6 (1.8)	ns	21.1 (8.6)	22.1 (10.7)	ns	38.9 (9.4)	39.1 (8.5)	ns	34.9 (8.8)	37.5 (9.8)	ns
T1	1.4 (1.2)	1.4 (1)	ns	45.5 (13.9)	39.5 (14.9)	ns	40.9 (9)	41.9 (7.1)	ns	36.5 (10.3)	38.4 (7)	ns
T2	1 (1.4)	0.8 (1)	ns	62.8 (18.6)	51.4 (22.3)	0.057[a]	42.5 (6.9)	42.9 (6)	ns	38.8 (7.5)	40.7 (10.9)	ns
T3	0.21 (0.5)	0.3 (0.6)	ns	84.6 (15.5)	84.5 (18)	ns	45.1 (6.4)	48 (5.9)	ns	43.5 (9)	44.1 (7.1)	ns
Delta												
T1–T0	0.7 (1.8)	0.2 (1.8)	ns	24.4 (12.8)	17.4 (9.3)	0.04b	2 (5.2)	2.7 (8.1)	ns	1.6 (6.3)	0.9 (6.3)	ns
T2–T0	0.9 (1.9)	0.7 (1.7)	ns	41.6 (16.6)	29.3 (20.5)	0.024b	3.5 (8.6)	3.8 (7.2)	ns	3.9 (1.3)	8.5 (1.6)	ns
T3–T0	1.8 (1.6)	1.3 (1.6)	ns	63.5 (17.9)	63.4 (20.2)	ns	6.2 (10.8)	8.8 (10)	ns	8.6 (10.3)	6.6 (11.1)	ns
T2–T1	0.3 (1.6)	0.5 (1.1)	ns	17.3 (17.5)	11.9 (16.4)	ns	1.5 (7.8)	1.1 (5.3)	ns	2.3 (9.3)	2.3 (9)	ns
T3–T1	1.1 (1.3)	1.1 (0.9)	ns	39.1 (20.2)	45 (21)	ns	4.2 (10.8)	6.1 (9.9)	ns	7 (11.3)	5.7 (10.7)	ns

Abbreviations: ANOVA, analysis of variance; MCS, mental health composite; *n*, number; ns, non-significant; PCS, physical component summary; SD, standard deviation; SF, short form; VAS, visual analog scale.
[a]One Way ANOVA.
[b]Mann–Whitney *U*-test.

Table 3 Differences of outcome measures with respect to sex

	VAS mean (SD)		*p*-Value[a]	Constant–Murley Mean (SD)		*p*-Value[a]	SF-12—PCS Mean (SD)		*p*-Value[a]	SF-12—MCS Mean (SD)		*p*-Value[a]
	Men ($n = 30$)	Women (19)		Men ($n = 30$)	Women ($n = 19$)		Men ($n = 30$)	Women ($n = 19$)		Men ($n = 30$)	Women ($n = 19$)	
T0	1 (1.4)	3 (1.9)	<0.0005	23.5 (9.9)	18.4 (7.9)	0.08	40.7 (8)	36.3 (9.8)	0.09	40.7 (8)	36.3 (9.8)	0.002
T1	1.2 (0.9)	1.6 (1.3)	ns	42.7 (14.8)	43.3 (14.4)	ns	42.2 (7.3)	40 (9.5)	ns	39.8 (8.3)	33.3 (8.8)	0.012
T2	0.6 (1)	1.5 (1.5)	0.022	57.7 (19.2)	58.3 (23.7)	ns	43.4 (5.4)	58.3 (23.7)	ns	41.4 (9.3)	36.9 (8.1)	0.034
T3	0.2 (0.5)	0.3 (0.7)	ns	84.3 (13.6)	84.9 (20.6)	ns	48.3 (5.5)	43.3 (6.4)	0.01	46 (5.8)	40.2 (10.1)	0.054
Delta												
T1–T0	0.2 (1.4)	1.5 (1.9)	0.002	19.2 (11.5)	24.8 (11.9)	ns	1.5 (7.1)	3.6 (5.5)	ns	0.7 (6.6)	2.2 (5.7)	ns
T2–T0	0.4 (1.3)	1.5 (2.3)	0.07	34.1 (17.3)	39.8 (21.9)	ns	2.7 (8.5)	5.1 (6.9)	ns	2.2 (9)	5.8 (7.7)	ns
T3–T0	0.8 (1.4)	2.7 (2)	0.001	60.8 (16.2)	66.5 (22)	0.049	7.6 (9.9)	6.9 (11.6)	ns	6.8 (9.1)	9.2 (12.8)	ns
T2–T1	0.6 (1)	0.06 (1.8)	ns	15 (13.7)	15 (21.8)	ns	1.2 (7.6)	1.5 (5.4)	ns	1.5 (9.7)	3.6 (8)	ns
T3–T1	1 (0.9)	1.2 (1.4)	ns	41.6 (20.5)	41.6 (17.2)	ns	6.1 (9.7)	3.3 (11.3)	ns	6.2 (10.9)	6.9 (12.8)	ns

Abbreviations: MCS, mental health composite; *n*, number; ns, non-significant; PCS, physical component summary; SD, standard deviation; SF, short form; VAS, visual analog scale.
[a]Mann–Whitney *U*-test.

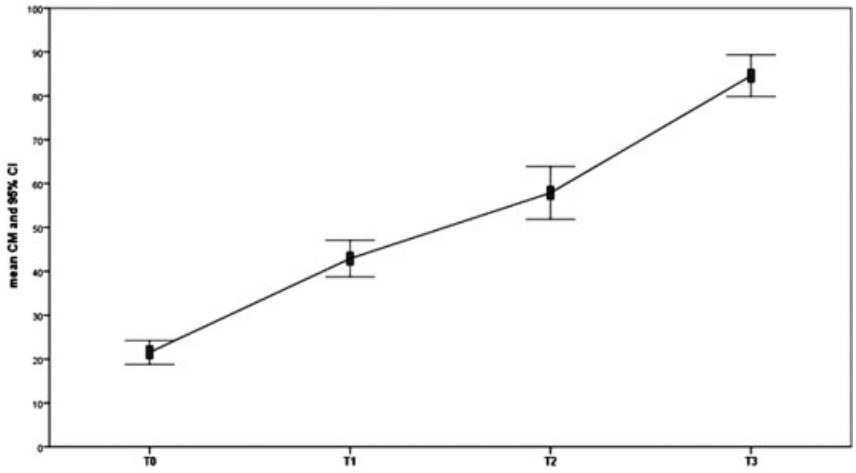

Fig. 2 Constant–Murley score as mean and 95% confidence interval along the follow-up. CI, confidence interval; CM, Constant–Murley.

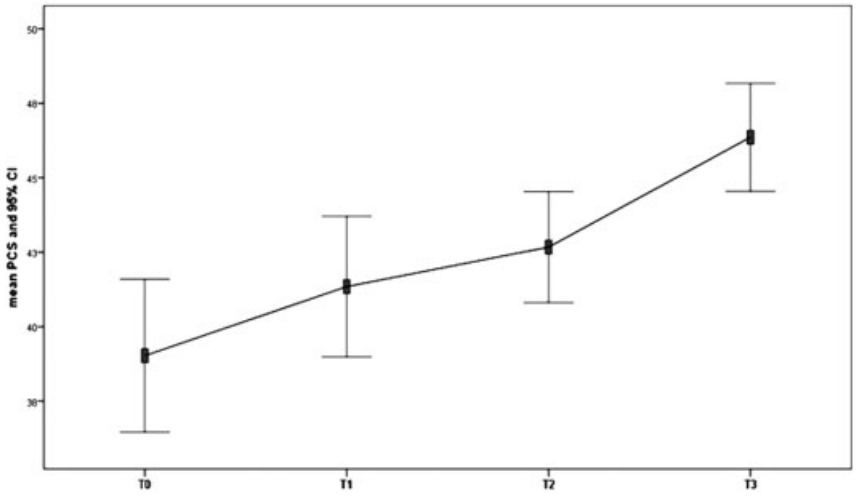

Fig. 3 SF-12 PCS as mean and 95% confidence interval along the follow-up. PCS, physical component summary; SF, short form.

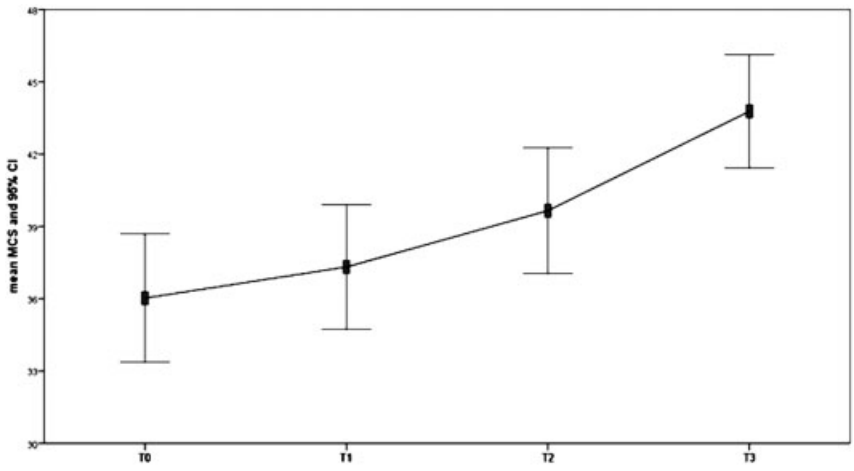

Fig. 4 SF-12 MCS as mean and 95% confidence interval along the follow-up. CI, confidence interval; MCS, mental component summary; SF, short form.

reported by Gandek et al,[23] it was in good agreement with the value reported by Cole et al[25] at 1-year follow-up in a similar study. MCS was instead quite similar to the reference value reported by Gandek et al,[23] but was below the average value reported by Cole et al[25] As suggested by Gandek et al,[23] these differences could be country-specific and should be interpreted with caution.

Some differences were found also for MCS in women who had a lower score compared with men both at the beginning of the rehabilitation treatment, and up to 3-month follow-up. This is consistent with the higher pain reported by females and requires some further investigation to better understand its significance. In addition, MCS was correlated with age, showing a lower improvement in older patients. Health perception from the mental perspective in terms of vitality, social functioning, emotional role, and mental health can depend on several variables, which are not necessarily exclusively related to shoulder function. The quite complete absence of pain and the good function of the shoulder as measured by the Constant–Murley score cannot entirely explain this finding, and further insight is needed.

In the present study, no differences were found between patients with traumatic lesions and those with degenerative lesions for pain and health perception, while better results were obtained for Constant–Murley score in patients with degenerative lesions. This is conflicting with results presented by Jeong et al,[10] who observed that patients with acute-on chronic full-thickness rotator cuff tears had greater improvement in Constant–Murley score compared with chronic patients. Although we repaired tears within 3 months from the acute lesion, which is reported as an acceptable time interval (from lesion to surgery) to provide good clinical outcomes,[26] many variables can account for this difference such as age, tear extension, and rehabilitation protocol.

As previously reported,[26,28] the number of tendons repaired does not seem to affect the clinical outcome and does not seem to have impact on pain at rest. Furthermore, protective effects of subacromial decompression have been suggested for long-term result.[26] Unfortunately, due to the small number of patients who did not have the subacromial bursectomy, a statistical analysis to investigate possible differences was not possible in the present study. Finally, the Constant–Murley score does not confirm the results of a recent study[29] on the treatment of LHB, which would negatively affect the functional outcome.

Conclusion

The present study has some limitations. Indeed, the lack of a control group of patients undergoing to different rehabilitation training impairs internal validity of the study. Actually, the study reflects the clinical practice in our Institution where surgeons and physiatrists agreed in performing a standard rehabilitation program in cuff rotator tears, based on evidences reporting superior clinical benefits of delayed motion on early shoulder motion. Furthermore, although a detailed rehabilitation program was given to patients to continue rehabilitation after the period spent in our Institute, the lack of information regarding the adherence to any rehabilitation program after hospital discharge up to the last follow-up at 12 months, which could have influenced the outcome, has to be considered.

In conclusion, the present study confirmed satisfactory results 1 year after rotator cuff repair using a traditional 4-week immobilization followed by a 2-week rehabilitation protocol without occurrence of tendon re-tearing.

Conflict of Interest
None declared.

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