Are Patients Who Undergo the Latarjet Procedure Ready to Return to Play at 6 Months?

A Multicenter Orthopaedic Outcomes Network (MOON) Shoulder Group Cohort Study

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Background: The Latarjet procedure is growing in popularity for treating athletes with recurrent anterior shoulder instability, largely because of the high recurrence rate of arthroscopic stabilization, particularly among contact athletes with bone loss.

Purpose: (1) To evaluate return of strength and range of motion (ROM) 6 months after the Latarjet procedure and (2) to determine risk factors for failure to achieve return-to-play (RTP) criteria at 6 months.

Study Design: Case-control study; Level of evidence, 3.

Methods: A total of 65 athletes (83% contact sports, 37% overhead sports; mean ± SD age, 24.5 ± 8.2 years; 59 male, 6 female) who enrolled in a prospective multicenter study underwent the Latarjet procedure for anterior instability (29% as primary procedure for instability, 71% for failed prior stabilization procedure). Strength and ROM were assessed preoperatively and 6 months after surgery. RTP criteria were defined as return to baseline strength and <20° side-to-side ROM deficits in all planes. The independent likelihood of achieving strength and motion RTP criteria at 6 months was assessed through multivariate logistic regression modeling with adjustment as needed for age, sex, subscapularis split versus tenotomy, preoperative strength/motion, percentage bone loss, number of prior dislocations, preoperative subjective shoulder function (American Shoulder and Elbow Surgeons and Western Ontario Shoulder Instability Index percentage), and participation in contact versus overhead sports.

Results: Of the patients, 55% failed to meet ≥1 RTP criteria: 6% failed for persistent weakness and 51% for ≥20° side-to-side loss of motion. There was no difference in failure to achieve RTP criteria at 6 months between subscapularis split (57%) versus tenotomy (47%) (*P* = .49). Independent risk factors for failure to achieve either strength or ROM criteria were preoperative American Shoulder and Elbow Surgeons scores (per 10-point decrease: adjusted odds ratio [aOR], 1.61; 95% CI, 1.14-2.43; *P* = .006), Western Ontario Shoulder Instability Index percentage (per 10% decrease: aOR, 0.61; 95% CI, 0.38-0.92; *P* = .01), and a preoperative side-to-side ROM deficit ≥20° in any plane (aOR, 5.01; 95% CI, 1.42-21.5; *P* = .01) or deficits in external rotation at 90° of abduction (per 10° increased deficit: aOR, 1.64; 95% CI, 1.06-2.88; *P* = .02).

Conclusion: A large percentage of athletes fail to achieve full strength and ROM 6 months after the Latarjet procedure. Greater preoperative stiffness and subjective disability are risk factors for failure to meet ROM or strength RTP criteria.

Keywords: Latarjet; shoulder instability; athletes; return to play; return to sports; range of motion; strength

The Latarjet procedure is growing in popularity for treating athletes with recurrent anterior shoulder instability. This is largely due to the high recurrence rate of arthroscopic stabilization, particularly among contact athletes with bone loss.[10,17,26,47,52] The Latarjet was originally described in 1954,[20,21,29,32,34] and it remains an effective treatment for anterior shoulder instability. Recent reports suggest a recurrent dislocation rate after Latarjet of 3% to 15%,[4,22,24,31,43,56] as compared with 6% to 50% after arthroscopic Bankart repair.[10,17,43,52]

Return to play (RTP) after anterior stabilization surgery has traditionally been 6 months postoperatively

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despite little objective support for this time frame.[8,25] Ciccotti et al[8] found in a recent systematic review that 75.8% of all studies published regarding anterior shoulder instability surgery cite time alone as the only RTP criterion, with 51.9% based on the 6-month postoperative time point. Only 18.9% utilized assessment of strength and 13.8% range of motion (ROM). Some have suggested that athletes should simply have near normal strength and ROM before being allowed to RTP,[35] and earlier RTP protocols have been utilized in recent years.[9] These are based on the idea that rehabilitation is limited only by osseous healing of the coracoid graft, and successful RTP as early as 8 weeks postoperatively has been described.[39] RTP in collision and contact athletes remains less than perfect, however. Only 49% return to their preoperative sports level.[45] From National Football League Combine data, an estimated <1% of players have undergone Latarjet, and on average those players played less than half of eligible snaps during their rookie season.[30]

The percentage of patients undergoing Latarjet who reach full strength and ROM by 6 months postoperatively is not known. The primary purpose of this study was to evaluate how often athletes achieve full strength in all planes and equal side-to-side ROM (defined as a <20° difference in ROM in all planes) 6 months after Latarjet. The secondary purpose was to identify risk factors predicting failure in achieving these criteria. We hypothesized that the majority of patients would not have full return of strength or ROM at 6 months after Latarjet.

METHODS

Study Design

Our research collaborative comprises 26 sports medicine or shoulder fellowship-trained surgeons from 10 academic and private groups throughout the United States, previously described.[6,7,27] This prospective cohort study enrolled patients undergoing surgical treatment for shoulder instability between November 5, 2012, and August 30, 2018. Baseline demographic data, patient-reported metrics, physician examination data, and surgical data were collected. After Latarjet surgery, patients followed the standard anterior shoulder stabilization postoperative care, sling usage, and rehabilitation protocols at all sites,[42] and outcomes were measured at the 6-month follow-up visit. Participants provided informed consent with institutional review board–approved forms and procedures.

Participants

Patients were enrolled at any of the 10 participating institutions. Patients were eligible if they were between the ages of 12 and 99 years old and undergoing the Latarjet procedure for a diagnosis of anterior shoulder instability. The study included primary Latarjet and Latarjet performed after previously failed stabilization surgery. All forms of subscapularis management as it pertains to the Latarjet technique were included. Exclusion criteria included nonathletes (ie, patients not competing in recreational or competitive sports at any level) and patients with concomitant rotator cuff repair, posterior or multidirectional instability, anterior bone block procedures other than the Latarjet, and workers' compensation claims. Of the 71 patients who underwent Latarjet and were enrolled in the study, 6 were excluded (all were nonathletes). Sixty-five patients were athletes and met inclusion criteria (mean ± SD age, 24.5 ± 8.2 years; 91% male). The available sample is a convenience sample from an existing multicenter cohort study data set. There are no prior published data on passage rates of RTP criteria for the Latarjet procedure. According to an a priori power analysis, this sample (n = 65) was adequately powered to assess the primary study aim. Specifically, it was powered to determine the rate of passage of RTP criteria within a 12% margin of error at 95% confidence, which the authors believe to be a clinically acceptable margin of error.

Data Collection

A detailed physical examination of each patient was performed and documented by the operating surgeon. At the baseline preoperative and 6-month follow-up visits, participants were evaluated for ROM in forward elevation,

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abduction, external rotation (ER) at the side, ER in 90° of abduction, and internal rotation at 90°. Strength was assessed with a standard 5-point muscle-testing scale with forward elevation, abduction, ER with elbow at side, liftoff test, and belly press test. All measurements were performed on the surgical extremity and contralateral extremity, and no specific device was used for strength or ROM. Contralateral extremity measures were used to assess if any preoperative deficit was present. Postoperative assessment and return to baseline were established upon measuring the same extremity. The same surgeon performed physical examination at both assessments. Preoperative Western Ontario Shoulder Instability Index (WOSI)[48] and American Shoulder and Elbow Surgeons (ASES)[37,55] scores were recorded for each patient. The Latarjet procedure was performed as previously described.[5,21,29,32,36] No arthroscopic Latarjet procedures were performed. Postoperatively, patients participated in a standardized protocol that was used at all 10 participating institutions.[42] Operative forms were filled out immediately after each surgical procedure and documented subscapularis split versus tenotomy, Latarjet preceded by arthroscopic debridement, and Latarjet performed with inferior capsular shift. Furthermore, the size and percentage of bone loss for any bony Bankart/glenoid bone deficiency were assessed radiographically and arthroscopically. Hill-Sachs lesion was assessed in the same manner, and the width of the defect and the estimated percentage of the humeral head diameter were recorded. Investigators used their own preferred method to assess the amount of bone loss. Articular cartilage pathology on the humerus and glenoid was noted as well.

Definition of Outcome

Change between the baseline and 6-month follow-up visit was determined. As described in previous Multicenter Orthopaedic Outcomes Network (MOON) research, satisfactory RTP criteria were defined as having ROM within 20° of the baseline surgical extremity value in all planes and a strength measurement equal to or greater than the baseline value.[7] A failure to meet RTP criteria by the patient's 6-month visit was defined as ≥20° loss of ROM as compared with baseline in any plane or as strength grade less than the baseline value or both. Of note, this study does not directly comment on whether these individuals had successfully returned to sports at the 6-month postoperative point but rather on if they have successfully returned to baseline ROM and strength.

Statistical Analysis

All statistical analyses were performed with standard software packages (Stata, v 13.1 [StataCorp]; JMP, v 12.0 [SAS Institute]). Descriptive statistics were first generated for the entire sample. Percentages of failure to meet RTP criteria were estimated. The univariate associations between pre- and intraoperative variables and RTP criteria failure rates were determined with Student *t* tests and chi-square analysis as appropriate. Three multivariate logistic regression models were then created to assess the independent association between pre- and intraoperative variables and risk of failing to meet RTP criteria at 6 months: (1) failure to meet any RTP criterion (motion or strength), (2) failure to meet RTP motion criteria, or (3) failure to meet RTP strength criteria. All pre- and intraoperative variables presented in the current study were considered for inclusion in the multivariate models. The models were created with a backward selection method with an exit criterion of alpha >.05. To control for confounding, a change-in-estimate criterion of >15% was utilized; this is a robust method to assess for confounding in multivariate models.[33,38] For comparative purposes, the adjusted odds ratios and 95% CIs for risk factors that were significant ($P < .05$) in at least 1 model are also provided in models in which they were nonsignificant ($P > .05$). All biologically plausible interaction terms were tested in all models, none of which were significant ($P > .05$). Diagnostics were performed on all models, all of which demonstrated adequate goodness of fit ($P > .05$, Hosmer-Lemeshow chi-square test).

RESULTS

Patient and Injury Characteristics

Of the 65 patients in the current analysis (mean age, 24.5 ± 8.2 years; 91% male) (Table 1), instability started after an injury in 88%, a sporting injury in 80%, and a contact injury in 55%. In total, 83% were contact athletes, and 37% did overhead throwing or racquet sports. Seventy-four percent had >1-year duration of symptoms before surgery and a mean 3.2 ± 0.9 dislocations in the year before surgery. The mean Beighton score was 1.1 ± 2.1. The mean preoperative WOSI was 37.9% ± 17%, and the mean ASES score was 66.8 ± 20.8.

Surgical Procedure

Latarjet was performed in 71% of patients after having failed previous anterior shoulder stabilization procedures and as a primary operation in 29%. The most common amount of anterior glenoid bone loss was 11% to 20%, with 47% of patients having this amount (no bone loss, 14%; ≤10%, 9%; 21%-30%, 30%). Similarly, the most common size of the Hill-Sachs lesion was 11% to 20%, with 40% of all patients possessing this size (no Hill-Sachs, 23%; ≤10%, 30%; 21%-30%, 7%). Latarjet was performed concurrently with arthroscopic debridement in 17% of cases and with inferior capsular shift in 29%. A subscapularis tenotomy was utilized in 64% of cases and a subscapularis split in 36%.

Failure to Meet RTP Criteria

Preoperatively, 35% had ≥20° ROM deficit in any plane, and 11% had strength deficits. The mean preoperative WOSI was 37.9% ± 17%, and the mean preoperative

TABLE 1
Summary Statistics of Study Population[a] (N = 65)

	% or Mean ± SD
Age, y	24.5 ± 8.2
Sex	
Male	91
Female	9
Body mass index, kg/m^2	25.8 ± 3.7
Workers' compensation	0
Private insurer	92
Medicaid	8
Injured arm is dominant arm for throwing	46
Instability started after	
Injury	88
Sporting injury	80
Contact injury	55
Athlete	
Contact or overhead	100
Overhead	37
Contact	83
Duration of symptoms >1 y	74
Dislocations in past year	3.2 ± 0.9
Stabilization procedure	
Primary	29
Failed previous	71
Subscapularis	
Tenotomy	64
Split	36
Latarjet	
Preceded by arthroscopic debridement	17
With inferior capsular shift	29
Anterior glenoid bone loss	
None	14
≤10%	9
11%-20%	47
21%-30%	30
Hill-Sachs lesion	
None	23
≤10%	30
11%-20%	40
21%-30%	7
Beighton score	1.1 ± 2.1
Preoperative WOSI total, %	37.9 ± 17.0
Preoperative AESE shoulder score	66.8 ± 20.8
Range of motion	
External rotation	
Elbow at side	66.0 ± 15.3
Elbow at side, vs contralateral	2.9 ± 7.3
Elbow at 90° of abduction	82.3 ± 14.6
Elbow at 90° of abduction, vs contralateral	9.0 ± 14.3
Internal rotation	
Elbow at 90° of abduction	63.8 ± 17.4
Elbow at 90° of abduction, vs contralateral	3.3 ± 8.5
Forward elevation	170.6 ± 19.2
Forward elevation vs contralateral	–2.3 ± 13.5
Abduction	158.0 ± 27.1
Abduction vs contralateral	8.1 ± 25.3
Preoperative side-to-side ROM deficit ≥20°, any plane of motion	35
Preoperative full strength, 5 of 5	
External rotation	95
Internal rotation	97
Belly press	97
Liftoff	92
Forward elevation	95
Abduction	95
Preoperative weakness ≤4 of 5 strength, any plane of motion	11

[a]ASES, American Shoulder and Elbow Surgeons; ROM, range of motion; WOSI, Western Ontario Shoulder Instability Index.

TABLE 2
Rate of Failure to Meet Return-to-Play Criteria at 6 Months

	%
Persistent stiffness or weakness	55
Persistent weakness	6
Forward elevation	4
Internal rotation	3
External rotation	3
Abduction	2
Persistent stiffness ≥20° side-to-side loss of motion, any plane	51
External rotation deficit ≥20°	38
Internal rotation deficit ≥20°	31
Abduction or forward elevation deficit ≥20°	14

ASES score was 66.8 ± 20.8. At the 6-month follow-up, no episodes of recurrent instability, either subluxation or dislocation, had been reported. Of patients, 55% failed to meet RTP criteria as defined by either ≥20° loss of ROM in any plane as compared with baseline preoperative surgical extremity ROM or had a strength grade less than the baseline value or both (Table 2). Of these, 51% had decreased ROM, with ER in any plane being the most common (38%). Only 6% had persistent weakness. Table 3 illustrates rates of failing to meet criteria based on pre- and intraoperative factors. Of note, only 37% of overhead athletes failed to meet RTP criteria, while nonoverhead athletes failed at a rate of 74%. There was no appreciable difference in failure to meet RTP criteria based on undergoing Latarjet with or without prior surgery (50% vs 56%), subscapularis tenotomy versus split (57% vs 47%), or the use of an inferior capsular shift (no, 56%; yes, 53%). The amount of anterior glenoid bone loss and the size of the Hill-Sachs were not associated with failure to meet RTP criteria.

Independent Risk Factors for Failure to Meet RTP Criteria

After consideration of other factors, injury during a sporting event or participation in contact or overhead sports was not independently associated with meeting RTS criteria ($P > .05$, all comparisons). Independent risk factors for failure to achieve either strength or ROM criteria were greater preoperative shoulder symptoms (per preoperative ASES score, $P = .006$; WOSI percentage, $P = .01$) as well as a preoperative side-to-side ROM deficit ≥20° in any plane ($P = .01$) or, specifically, a preoperative deficit in ER at 90° of abduction ($P = .02$) (Table 4). Independent risk factors for failure to meet ROM criteria (without consideration for strength criteria) were deficits in ER at 90° of abduction ($P = .04$) and symptom duration >1 year ($P = .02$). No independent risk factors were identified for failure to meet strength criteria (without consideration for ROM criteria), although there was a trend toward significance for preoperative weakness (≤4 of 5 strength in any plane; $P = .06$).

TABLE 3
Overall RTP Failure Rates by Pre- and Intraoperative Factors[a]

	RTP Failure, %	*P* Value
Age, y		
<20	43	.25
20-29	65	
>29	50	
Sex		
Male	53	.53
Female	66	
Athlete		
Overhead	37	.03
Nonoverhead	74	
Contact	57	.50
Noncontact	45	
Stabilization procedure		
Primary	50	.64
Failed previous	56	
Subscapularis		
Tenotomy	57	.49
Split	47	
Inferior capsular shift		
No	56	.83
Yes	53	
Hill-Sachs lesion		
None	27	.06
≤10%	33	
11%-20%	39	
21%-30%	0	
Anterior glenoid bone loss		
None	50	.42
≤10%	20	
11%-20%	59	
21%-30%	56	
Preoperative weakness		
No, any plane of motion	54	.89
Yes	57	
Preoperative side-to-side ROM deficit		
<20° (symmetric), all planes	45	.03
≥20°, any plane of motion	73	

[a]ROM, range of motion; RTP, return to play.

DISCUSSION

This study describes what percentage of athletes undergoing Latarjet have return of full strength and ROM at 6 months postoperatively. A large percentage of athletes, 55%, did not return to baseline strength or ROM after Latarjet at 6-month follow-up and would be considered failing to meet RTP criteria. Identified independent risk factors for failure to meet ROM or strength RTP criteria included greater preoperative subjective shoulder disability (per ASES and WOSI scores) and preoperative stiffness relative to the contralateral shoulder. This rate of failure to meet RTP criteria is higher than a previous MOON group study, which noted that 36% of patients undergoing any type of anterior shoulder stabilization procedure failed to meet these criteria at 6 months. Within that study, 34% failed to return to baseline ROM (vs 51% in this study), and 2% failed to return to baseline strength (vs 6%).[7] There is a significant association between duration of symptoms longer than 1 year before surgery and failure to normalize ROM to within 20° of baseline at 6 months after Latarjet.

Pre- and intraoperative factors—including Latarjet performed for primary versus failed previous stabilization surgery, amount of anterior glenoid bone loss, size of Hill-Sachs defect, subscapularis split versus tenotomy, and whether the procedure was combined with arthroscopic debridement or inferior capsular shift—were not associated with failure to meet RTP criteria. Previous data suggested that subscapularis tenotomy may lead to subscapularis muscular atrophy and fatty degeneration,[50] as well as weaker internal rotation strength and durability with isometric and isokinetic testing.[12,44] However, the clinical data in this study did not show any significant difference between the techniques. Furthermore, younger age is a risk factor for repeat dislocation.[41,51,53] Our data did not suggest an age discrepancy in regard to failure to meet RTP criteria.

A large percentage of athletes, 55%, failed to meet the defined RTP criteria at 6 months. However, recent meta-analyses noted that the average time for successful RTP after Latarjet is 5.3 to 5.8 months,[23,24] and some report a 3-month RTP time frame. Data on actual RTP for our cohort of athletes were not available, but the discrepancy between these numbers suggests that RTP criteria should be reexamined. These data suggest that many athletes are returning to play despite not having returned to baseline strength and ROM. On this basis, we must then ask the following: (1) Are these athletes returning too quickly? and (2) do we need to change our RTP criteria?

RTP rate is highly variable, based on sports and position. In collision and contact athletes, only 49% return to their preoperative sports level.[45] Less than 1% of National Football League athletes are playing with a previous Latarjet, and those who are playing are on the field for less than half of all eligible plays.[30] This challenge is not limited to contact athletes only, as a recent 5-year outcome study regarding remplissage demonstrated that while 95.5% of athletes return to sport, only 81% returned to the same level, and 65.5% of overhead throwers had significant difficulty throwing.[14] Given this, RTP criteria after Latarjet need to be closely scrutinized. Perhaps the lack of strength or ROM found in this study could be contributing to these decreased RTP and sport rates.

Recurrent instability rates after the Latarjet procedure are lower than after arthroscopic Bankart repair, and the popularity of this procedure continues to grow.[5,10,13,16-18,28,43,52] While time is certainly a necessary metric for RTP, it would seem that time alone is not sufficient for directing RTP.[8] Unfortunately, data regarding healing time after anterior shoulder stabilization are limited.[1] The importance of strength and ROM in the dynamic athlete's joint is well-known,[40,49] but the threshold of "functional" postoperative strength and ROM that allows for safe return to sport is not. Safe return to sport will inherently vary by the nature of the sport and the position of the athlete, with an overhead throwing athlete such as a baseball pitcher having much different functional demands than a professional rugby player or wrestler.[14] Some sports and positions would likely tolerate a loss of 20° ER without

TABLE 4
Adjusted Odds of Failure to Meet RTP Criteria at 6 Months[a]

	Adjusted Odds Ratio (95% CI)	*P* Value
Failure of strength or ROM criteria		
Preoperative ASES shoulder score	1.61[b] (1.14-2.43)	.006
Preoperative WOSI %	0.61[b] (0.38-0.92)	.01
≥20° side-to-side ROM deficit (any plane) or side-to-side difference ER at 90° abduction	5.01 (1.42-21.5); 1.64[c] (1.06-2.88)	.01; .02
Symptom duration >1 y	2.01 (0.44-7.81)	.29[d]
Failure of ROM criteria		
Preoperative ASES score	1.19[b] (0.91-1.58)	.22[d]
Preoperative WOSI %	0.96[b] (0.69-1.33)	.81[d]
≥20° side-to-side ROM deficit (any plane) or side-to-side difference ER at 90° abduction	2.80 (0.96-8.80); 1.51[c] (1.02-2.40)	.06[d]; .04
Symptom duration >1 y	4.54 (1.25-20.2)	.02
Failure of strength criteria		
Preoperative ASES score	1.65[b] (0.91-3.50)	.10[d]
Preoperative WOSI %	0.52[b] (0.25-1.22)	.18[d]
Preoperative weakness, any plane	10.9 (0.88-214)	.06[e]
Symptom duration >1 y	1.15 (0.09-9.60)	.89[d]

[a]All variables listed in Table 1 were considered for inclusion in each multivariate model. ASES, American Shoulder and Elbow Surgeons; ER, external rotation; ROM, range of motion; RTP, return to play; WOSI, Western Ontario Shoulder Instability Index.
[b]Per 10-point decrease.
[c]Per 10° increase.
[d]For comparative purposes, the adjusted odds ratios and 95% CIs for risk factors that were significant ($P < .05$) in at least 1 model are also provided in models in which they were nonsignificant ($P > .05$).
[e]No risk factors significantly predicted failure of strength RTP criteria; preoperative weakness approached significance at $P = .06$.

an issue as long as the shoulder remained strong and stable. An argument could even be made that a modest loss of ER is perhaps protective for some athletes, making them less likely to dislocate without impeding function, depending on their sport and position. Perhaps the optimal approach may be to transition away from strict chronologically based RTP criteria and toward sport-specific, functionally based metrics that consider objective and subjective findings. This multidisciplinary approach has been widely instituted after ACL reconstruction, with promising early outcomes.[2,3,11]

This study has several limitations. Our main outcome of return to baseline ROM and strength was recorded without use of a specific device for objective measure; however, there is known fair to good reliability between visual estimation and use of a goniometer.[19,46,54] In addition, manual muscle testing is unlikely to detect more subtle strength deficits. Also, the definition of symmetric baseline ROM being within 20° is based on MOON group surgeons' consensus[7] and may not be exact. Furthermore, we were unable at this early time point to include measurements of patient satisfaction or pain. Also, the study identified whether patients failed to meet designated RTP criteria, but it did not assess actual rates of return to recreational, collegiate, or professional sport. Data on actual date of release to sporting activity were not collected at 6 months, but there are plans to do so with future long-term outcome studies. This study was adequately powered to assess the primary study aim (what is the percentage failure to meet RTP criteria?) within a clinically acceptable margin of error, and our sample size was reasonable as compared with the existing Latarjet literature.[15] However, we were likely underpowered to reliably identify all independent risk factors for failing to meet RTP criteria, particularly strength criteria. In addition, the proportion of female patients in the study was low, and although this likely reflects the sex balance of patients with shoulder instability, the ability to assess sex-based differences was limited. Despite these potential limitations, this is the largest multicenter prospective study to evaluate strength, ROM, and RTP criteria after Latarjet surgery.

CONCLUSION

A large percentage of athletes, 55%, fail to return to full baseline strength and ROM 6 months after Latarjet. Greater preoperative stiffness and subjective disability are risk factors for failure to meet ROM or strength RTP criteria. Given that many athletes return to sport well before 6 months despite not having return of full strength and ROM, RTP criteria after Latarjet should be transitioned away from strict chronological measures and toward sport- and position-specific, functionally based metrics that consider objective and subjective findings.

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