Return to Sports after Latarjet Surgery: Systematic Literature Review

Ignacio Tanoira, Luciano Rossi, Juan Víctor A. Franco, Camila M. Escobar Liquitay, Ignacio Pasqualini, Maximiliano Ranalletta

Shoulder Pathology Unit, Orthopedics and Traumatology Service, Orthopedics and Traumatology Institute "Prof. Dr. Carlos E. Ottolenghi", Hospital Italiano de Buenos Aires (Buenos Aires, Argentina)

ABSTRACT

Background: The purpose of this study was to describe rates of return to sports and the level achieved by patients after a Latarjet procedure. **Methods:** We followed a protocol registered in PROSPERO (registration number CRD42018107606). A literature search was performed in May 2019 in MEDLINE, EMBASE, CENTRAL and clinical trials records. We used the GRADE approach for the assessment of the overall quality of the evidence per outcome. We included studies (evidence level I to IV) evaluating return to sports following shoulder stabilization with the Latarjet procedure with a minimum 2-year follow-up. **Results:** We included 24 studies, including 1436 athletes, all treated surgically after an average follow-up of 57 months (range 24 to 240). The overall rate of return to sport ranged from 65% to 100%, including 23% to 100% at an equivalent level of play. The average time for return to sport was 6 months (range, 1 - 36 months). Competitive athletes appeared to return to the same level of competition and this difference was not statistically significant (p = 0.32). The quality of the evidence was very low due to the study design (level IV evidence), study limitations and inconsistency. **Conclusion:** Most athletes with glenohumeral instability returned to sport; however, the level maintained after shoulder stabilization with the Latarjet procedure varied substantially. The average time to return to sports was 6 months and results were equally favorable in competitive and recreational athletes.

Key words: Glenohumeral instability; return to sports; Latarjet.

Level of Evidence: IV

Retorno al deporte luego de una cirugía de Latarjet: Revisión sistemática de la literatura.

RESUMEN

Introducción: El objetivo de este estudio fue describir las tasas de retorno al deporte y el nivel alcanzado por los pacientes con inestabilidad de hombro luego del procedimiento abierto y artroscópico de Latarjet. **Materiales y Métodos:** Seguimos un protocolo prespecificado y registrado en PROSPERO. Evaluamos la calidad de los estudios y utilizamos el sistema GRADE para evaluar la calidad general de la evidencia obtenida en los resultados. Incluimos estudios que evalúan el retorno al deporte de los pacientes luego de una cirugía de Latarjet con un seguimiento mínimo de 2 años. **Resultados:** Se incluyeron 24 estudios, con 1436 atletas, todos con cirugía y un seguimiento promedio de 57 meses (rango 24-240). La tasa general de retorno al deporte varió del 65% al 100% de los pacientes, de ellos, el 23-100% retornó al mismo nivel. El tiempo promedio de retorno al deporte fue de 6 meses (rango 1-36). El nivel de evidencia fue bajo debido a las características de los estudios incluidos (nivel de evidencia IV), las limitaciones de los estudios y sus inconsistencias. **Conclusiones:** La mayoría de los atletas con luxación recidivante de hombro sometidos a una cirugía de Latarjet retoman la práctica deportiva; sin embargo, el nivel alcanzado varía sustancialmente. El tiempo promedio de retorno al deporte fue de 6 meses, y no hubo diferencias significativas entre los deportistas competitivos y recreacionales.

Palabras clave: Inestabilidad glenohumeral; retorno al deporte; Latarjet.

Nivel de Evidencia: IV

Received on March 4th, 2020. Accepted after evaluation on September 28th, 2020 • IGNACIO TANOIRA, MD • ignacio.tanoira@hiba.org.ar https://orcid.org/0000-0002-2869-2390

How to cite this article: Tanoira I, Rossi L, Franco JVA, Escobar Liquitay C, Pasqualini I, Ranalletta M. Return to Sports after Latarjet Surgery: Systematic Literature Review. *Rev Asoc Argent Ortop Traumatol* 2021;86(2):263-280. https://doi.org/10.15417/issn.1852-7434.2021.86.2.1068

INTRODUCTION

The optimal management of recurrent shoulder instability with significant glenoid bone defect remains a challenging topic.[1] Glenoid and humeral bone defects are found in more than 90% of recurrent shoulder dislocations.[2] The high recurrence rates (30-60%) observed after open or arthroscopic Bankart repair in patients with significant bone defects of the glenoid cavity, the humerus, or a combination of both, lead many surgeons to choose glenoid bone reconstruction procedures to treat this pathology.[3,4,5] Among them, the most commonly used technique is Latarjet surgery.[5,6] In this procedure, three effects are combined with the aim of improving joint stability, achieving a "triple effect" stabilization.[1] First, the coracoid bone augments glenoid surface, acting as a static restrictor and improving the safe arc which is needed for humeral translation before dislocation (osseous effect). Secondly, the accompanying tendon acts as a cinch over the humeral head, limiting anterior translation when the shoulder is adducted and in external rotation (cinch effect). Thirdly, the labrum and the anterior capsule are reattached to the glenoid and strengthened by the coracoacromial ligament (bumper effect).[7,8]

Although Latajet procedure presents proven results for the management of recurrent instability in the general population,[2,6,9-11] there is scant information regarding the return to sports and sport level. One of the main expectations of athletes, independently from age and competitive level, is to be able to return to sport practice as soon as possible and at the same level as before the injury. The chosen surgical technique must not only achieve a stable shoulder, but also a safe return to sports. Consequently, this subgroup of patients represents a challenge for the shoulder surgeon.[12]

We have not found systematic literature reviews evaluating specifically the return to sports after an open or arthroscopic Latarjet surgery. Given that the published series on this technique are small, conducting this type of studies can provide solid information to surgeons and patients. The aim of this study is to conduct a systematic literature review to describe the rates of return to sports and level achieved by patients after undergoing Latarjet procedure for shoulder instability.

MATERIALS AND METHODS

This study was conducted in accordance with the Methodological Expectations of Systematic Reviews of Interventions[13] and the Cochrane Handbook.[14] The report follows the PRISMA (*Preferred Reporting Items for Systematic reviews and Meta-Analyses*) statement.[15] The protocol for this review was registered in the PROSPERO systematic review database (registration number CRD42018107606).

Search strategy

On May 24th, 2019, an electronic literature search was conducted in MEDLINE through PubMed, in Embase through Elsevier and in CENTRAL through the Cochrane Library, the International Clinical Trials Registry Platform (ICTRP) and clinictrials.gov. Furthermore, the references of each article were verified, and a manual search of potentially useful articles was conducted.

Selection criteria

The inclusion criteria comprised studies which, independently of language or level of evidence[1-4], evaluated the return to sports and clinical outcomes after an open or arthroscopic Latarjet procedure for the treatment of recurrent shoulder instability and glenoid bone defect in adult athletes. Primary results included: 1) return to sports, defined as the time to return to sporting activities, (2) return to the same level of competition, defined as the rate of patients who re-entered the same level of competition they were in before the injury. Additional results included time to return to sports, total complication rate and total rate of patients who underwent additional procedures (revisions).

Exclusion criteria comprised literature reviews, expert opinions, non-clinical studies, case reports and clinical trials which did not evaluate athletes or return to sports. Studies including patients who had other types of instability (for example, posterior or voluntary) or patients missing clinical or radiographic evaluations in a minimum follow-up of two years were also excluded. Two authors (IT and LR) selected the abstracts and analyzed them separately. When the abstract was considered relevant, the full-text article was analyzed. In case of disagreement between the authors, consensus was sought. If no consensus was reached, a third author was consulted (MR).

Quality appraisal of the studies

The quality of the included studies was assessed with the Quality Appraisal Tool for Case Series Studies developed by the Institute of Health Economics.[16] This tool was specifically developed and validated for quality appraisal of case series studies. It consists of 18 items covering the aim of the study, population characteristics, measurement of results, statistical analysis, results and conclusions, conflict of interests and references. This appraisal was independently conducted by two authors, reaching consensus in case of disagreement. We integrated these quality appraisals of the studies to summarize the general quality of the evidence, considering consistency of findings, evidence accuracy, results precision and publication bias evidence in accordance with GRADE Handbook guidelines, which allow to assess the quality of evidence and thus grade the strength of results.[17] We summarized these assessments in the summary tables using GRADEpro software.[18]

Data extraction and synthesis

Data extraction was standardized, predefined in accordance with the protocol. Two authors (IT and LR) independently extracted data. In case of disagreement between the authors, consensus was sought. If no consensus was reached, a third author was consulted (MR). It included 1) characteristics of the study (design, year and number of patients), 2) characteristics of the study participants (age, sex, sport, level of competition), 3) characteristics of shoulder instability (severity and size of bone defect, time elapsed between injury and surgery), 4) final follow-up clinical results, 5) rehabilitation and criteria for the return to sport and 6) primary and secondary results data.

Data were analyzed using STATA software. A random effects model was intended to be used to group proportions.[19] The percentage of total variance due to heterogeneity between studies was evaluated using I.[20] The thresholds were "low" (0% -40%), "moderate" (30% -60%), "substantial" (50-90%) and "considerable" (75% -100%). Average rate of return to sports was calculated with a confidence interval of 95%.[21] The rates of return to sports in the different studies, as well as the combined rate, were represented using a forest plot. We intended to explore heterogeneity by analyzing our pre-specified subgroups: type of sport, level of competition before surgery and type of surgery. However, data were insufficient to perform most of these analyses. Additionally, we analyzed bias effect by comparing low and high quality studies. Given that heterogeneity was high for primary findings, we decided to present findings in a narrative way.[22, 23] Publication bias was evaluated with a funnel plot representing the size of each study on the x-axis and the estimated proportion on the y-axis. Bias is suspected when the plot shows visible asymmetry. Additionally, we performed Egger's test for asymmetry.[24]

FINDINGS

The search strategy returned 1477 results: 1403 results were found in the database and 58 clinical trial references were retrieved. 135 duplicated references were excluded, leaving 1342 unique references. We examined unique references by reading titles and abstracts. From these references, we identified 130 potentially eligible citations that we reviewed in full text, of which we excluded 106. Addendum 2 includes the list of excluded studies and reasons for exclusion. Of the remaining references, we identified 24 studies that met inclusion criteria and three studies in progress. The PRISMA flow diagram for study selection is summarized in Figure 1.

Study characteristics and quality appraisal

All studies were case series (evidence level 4) with an average sample size of 56 (20 to 200 range) (Table 1). 14 studies were conducted in France, four in the United States, two in Argentina, two in Italy and one in Japan, Korea and Switzerland. The participants' average age was 26 years (21 to 31.5 range). All studies included predominantly male participants with recurrent instability. The percentage of osseous defect was rarely reported. The reports on the type of sport and sport level before surgery varied among the studies, for they depended on the classification system used by the authors. Most participants were involved in contact sports, which varied between "competitive" and "recreational". Average follow-up was 57 months (24 to 240 range). Of the 24 included studies, 21 performed an open Latarjet procedure, two studies performed arthroscopic surgeries and one study performed open and arthroscopic procedures (Table 1).

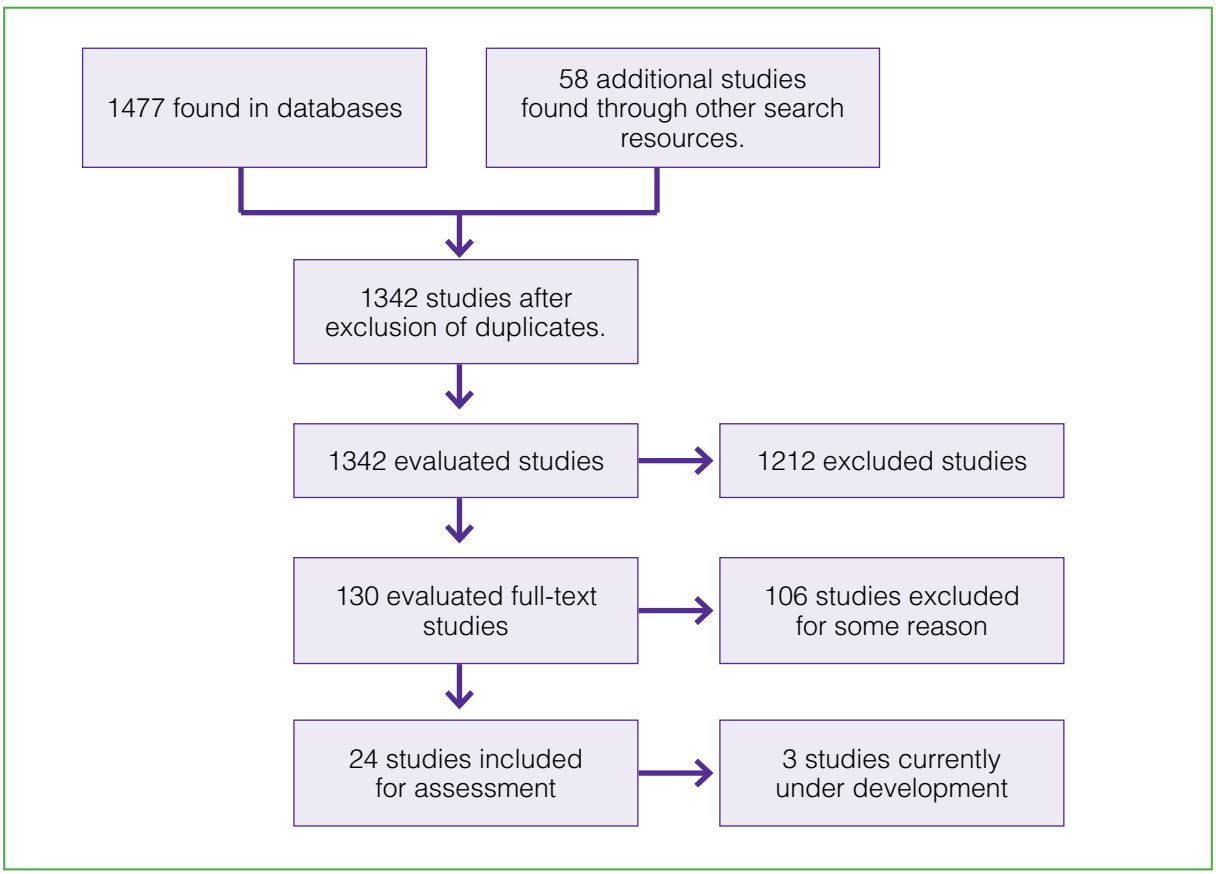

Figure 1. Study search and selection method, structured in accordance with PRISMA guidelines (*Preferred Reporting Items for Systematic Meta-Analyses*).

Most of the included studies did not report on the type of rehabilitation, except one study describing a "strengthening program"[15] and two studies describing a "stretching program".[42,47] None of the studies provided a description of the duration of rehabilitation. Most patients practiced contact and collision sports (n = 569). Only a minority of the studies described the specific names of the sports practiced by the patients. Among them, the most common was rugby (n = 218). None of the studies received funding. For detailed characteristics of the included studies, see Table 1. Most studies included in this review were low quality (Table 2). We found that most studies missed population and intervention characteristics. In some studies, moreover, findings and conclusions were incomplete, or limitations were not accounted for. Only three studies [37,38,42] were identified as high-quality.

Table 1. Characteristics of the included studies.

Author	Country	Sample size (n)	Analyzed (n)	Average age	Follow-up (months)	Sex (% male)	Osseous deficiency (%)	Type of sport	Level before surgery	Type of Surgery
El Andaloussi 2006 (25)	France	36	29	26	36	100%	Unspecified	Unspecified	Mainly recreational	Open
Burkhart 2007 (26)	USA	102	47	26.5	59.0	95%	Unspecified	Unspecified	Mainly competitive	Open
Neyton 2007 (27)	France	85	85	22.2	75	100%	13	Rugby	Mainly competitive	Open
Neyton 2012 (28)	France	37	37	23.4	144	100%	Unspecified	Rugby	Mainly competitive	Open
Bessiere 2013 (29)	France	57	51	25	66	96%	Unspecified	Unspecified	Mainly competitive	Open
Mizuno 2013 (30)	France	68	68	29.4	240	79%	Unspecified	Contact (19%)	Mainly recreational	Open
Bessiere 2014 (31)	France	93	93	26	72	90%	Unspecified	Contact (47%)	Mainly competitive	Open
Boileau 2014 (32)	France	64	64	24	35	80%	Unspecified	High-risk sports (84%)	Mainly recreational	Arthroscopic
Bouju 2014 (33)	France	78	78	26.7	156	60%	Unspecified	High-risk sports (59%)	Mainly recreational	Open
Tasaki 2015 (34)	Japan	42	40	21	30.5	99%	12.20	Rugby	Mainly competitive	Arthroscopic
Beranger 2016 (35)	France	47	47	27.9	46.8	98%	Unspecified	G1/G2 (64%)*	Mainly recreational	Open
Blonna 2016 (36)	Italy	30	30	31.5	63	86%	Unspecified	Colisión (53%)	Unspecified	Open
Marion 2016 (37)	France	58	43	27	29.8	77%	12-25	Unspecified	Mainly recreational	Open and Arthroscopic
Mook 2016 (38)	USA	39	38	26	38	84%	30	Unspecified	Unspecified	Open
Ropars 2016 (39)	France	79	79	26,3	55	68%	Only 36 patients	14 G1 - 8 G2 - 12 G3 - 10 G3 - 33 G4	Mainly competitive	Open
Yang 2016 (40)	USA	52	42	23.2	41	97%	19.70	Unspecified	Mainly competitive	Open
Zimmerman 2016 (41)	Switzerland	106	93	30.8	119	88.00%	Unspecified	Unspecified	Unspecified	Open
Ranalletta 2017 (42)	Argentina	68	65	26,8	44	95%	28	G1/G2* 80%	Mainly competitive	Open
Vadala 2017 (43)	Italy	24	24	27,2	24	91%	Unspecified	Unspecified	Unspecified	Open
Kee 2017 (44)	Korea	56	56	26	67	96%	Unspecified	Colisión (52%)	Mainly recreational	Open
L'Escalopier 2018 (45)	France	20	20	26	192	100%	Unspecified	Unspecified	Mainly competitive	Open
Baverel 2018 (20)	France	106	106	21	44	84%	Unspecified	Colisión (65%)	Mainly competitive	Open
Privitera 2018 (46)	USA	200	73	25.8	51,6	88%	10.60	Contact (82%)**	Mainly competitive	Open
Ranalletta 2018 (47)	Argentina	50	50	22,8	48	100%	28	Rugby	Mainly competitive	Open

(*) According to Allain's classification of sports: G1 to G4 depending on intensity.
(**) Includes: ice hockey, American football, rugby, lacrosse, field hockey.

Table 2. Quality assessment of each study.

Author / Year	Aim	Population	Intervention	Follow-up	Statistical analysis	Results and conclusions	Conflict of interests	General
El Andaloussi 2006	Low	Low	Low	Low	Low	Low	Low	Low
Burkhart 2007	High	Low	High	Low	Low	High	Low	Low
Neyton 2007	High	Low	High	High	High	Low	Low	Low
Neyton 2012	High	Low	High	Low	High	Low	High	Low
Bessiere 2013	High	Low	Low	High	High	High	Low	Low
Mizuno 2013	High	Low	Low	Low	High	Low	Low	Low
Bessiere 2014	High	Low	Low	High	High	High	Low	Low
Boileau 2014	High	Low	Low	High	High	High	Low	Low
Bouju 2014	High	High	High	High	High	Low	High	Low
Tasaki 2015	High	Low	Low	High	High	Low	High	Low
Beranger 2016	High	Low	Low	High	High	High	High	Low
Blonna 2016	High	Low	Low	High	High	High	Low	Low
Marion 2016	High	High	High	High	High	High	High	High
Mook 2016	High	High	High	High	High	High	High	High
Ropars 2016	High	High	High	High	High	High	Low	Low
Yang 2016	High	Low	Low	High	High	High	Low	Low
Zimmerman 2016	High	Low	Low	High	High	Low	High	Low
Kee 2017	High	Low	Low	High	High	High	High	Low
Ranalletta 2017	High	High	High	High	High	High	High	High
Vadala 2017	High	Low	Low	High	High	Low	Low	Low
L'Escalopier 2018	High	Low	Low	High	High	Low	Low	Low
Baverel 2018	High	Low	Low	High	High	High	Low	Low
Privitera 2018	High	Low	High	High	High	Low	High	Low
Ranalletta 2018	High	Low	High	High	High	Low	Low	Low

Return to sport and level of competition after return

Return to sport was evaluated in 1197 athletes in 23 studies. A meta analysis could not be conducted due to the high heterogeneity between the studies (I2 = 91.44% and I2 = 91.73% for primary findings). The rate of return to sport ranged from 65% to 100% (Figure 2). Sport level after return to sport was evaluated in 19 studies with 961 athletes who returned to sport. The rate of return to sport at the same level as before surgery ranged from 23% to 100% (Figure 3). Only seven studies, which included 355 participants,[5,6,34,35,42,46,47] reported on the time elapsed between surgery and return to sport. The average time to return to sport was 6 months, although the range within each study varied from 1 to 36 months. We did not find evidence of publication bias in funnel plots for these findings (Figure 4). Egger's test did not detect asymmetry (P value > 0.05). Seventeen studies reported on the level of competition before injury (Figure 5). 83 to 100% of recreational athletes and 65% to 100% of competitive athletes returned to the same level of competition and this difference was not statistically significant (p = 0.32). We explored the sources of heterogeneity by analyzing the subgroups on their level of competition before surgery in high- and low-quality studies; however, these analyses did not explain heterogeneity (Figures 5-6). In accordance with GRADE methodology, the quality of these findings is very low due to the characteristics of the study design, its limitations and inconsistency (Table 3).

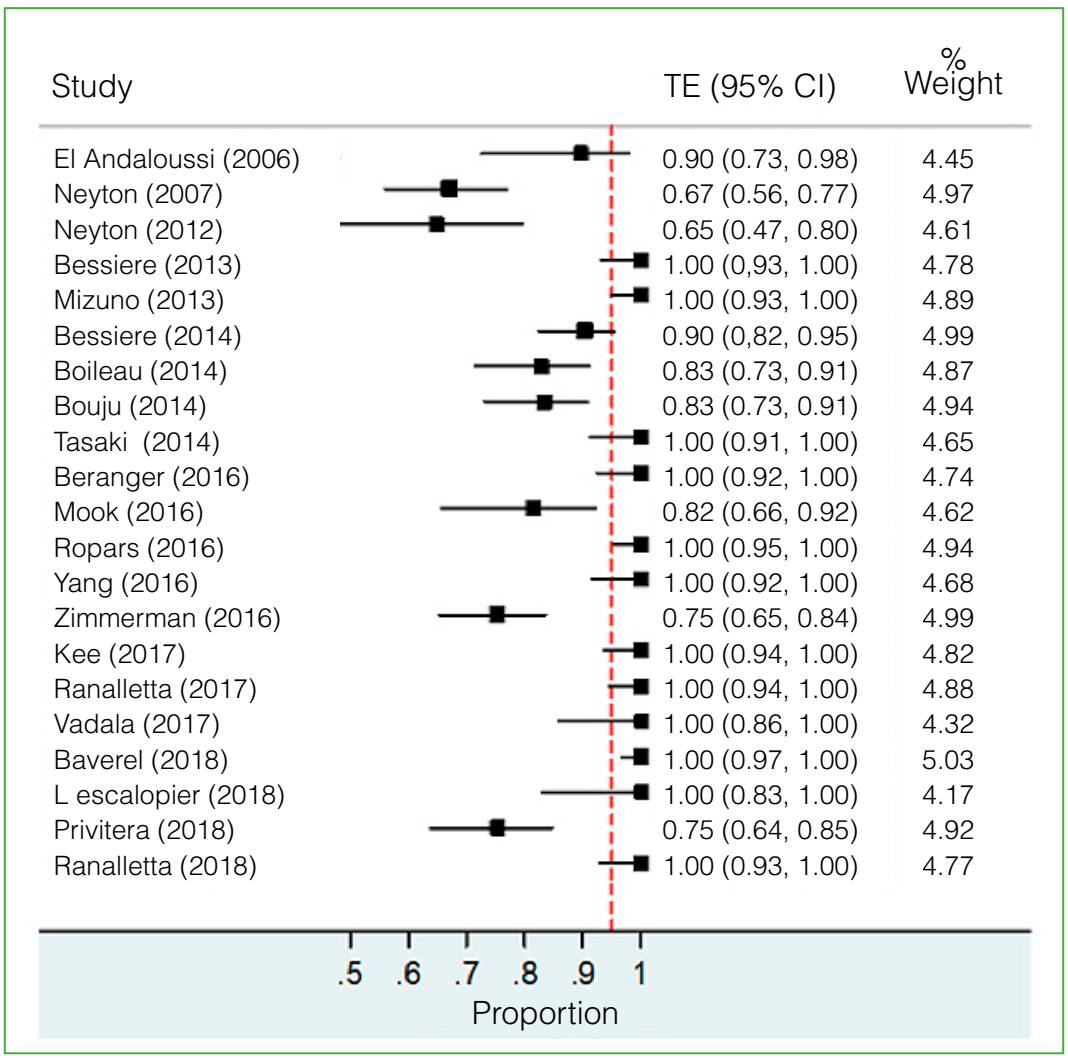

Figure 2. Return to sport after Latarjet surgery.

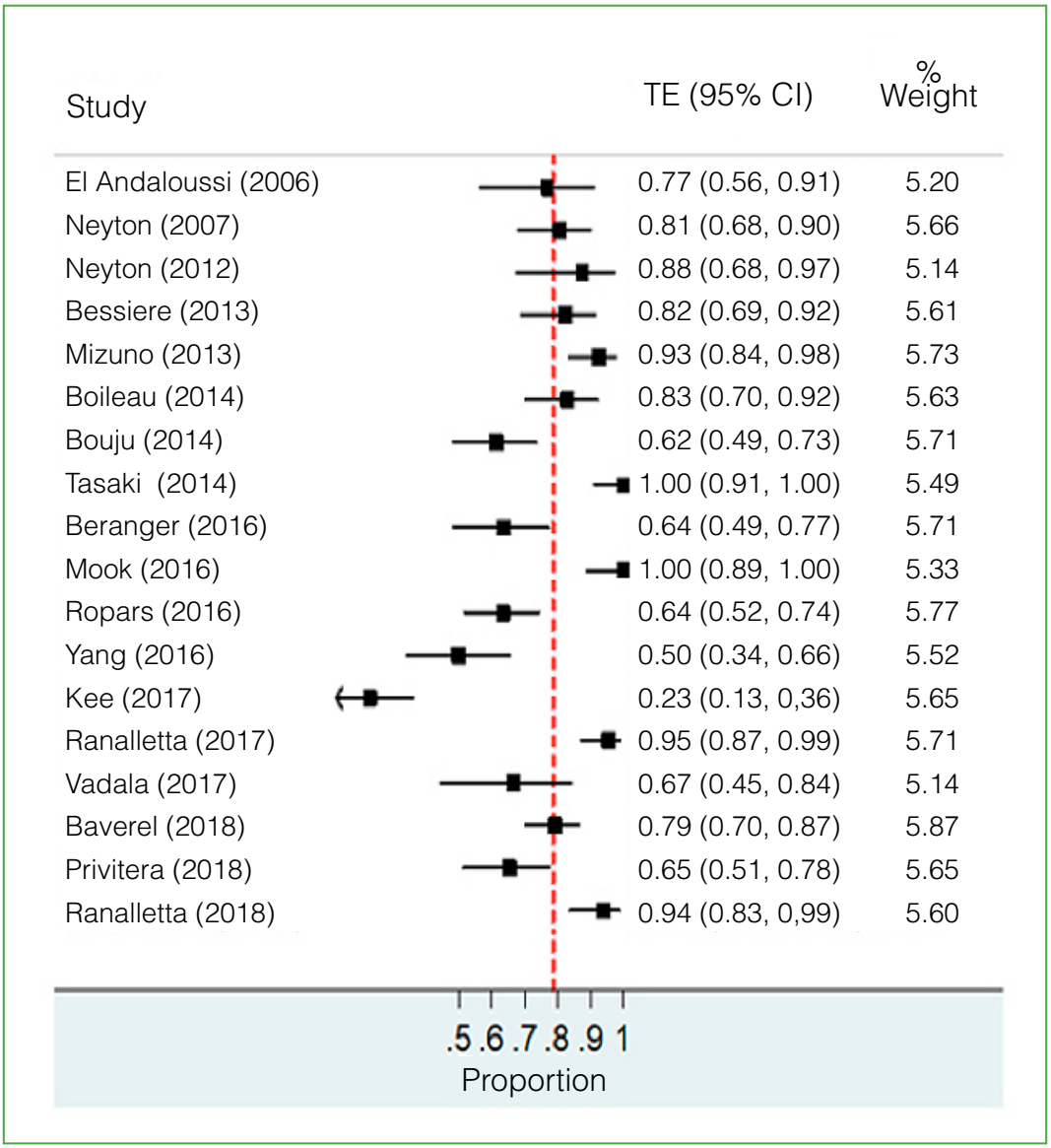

Figure 3. Return to the same level of competition after Latarjet surgery.

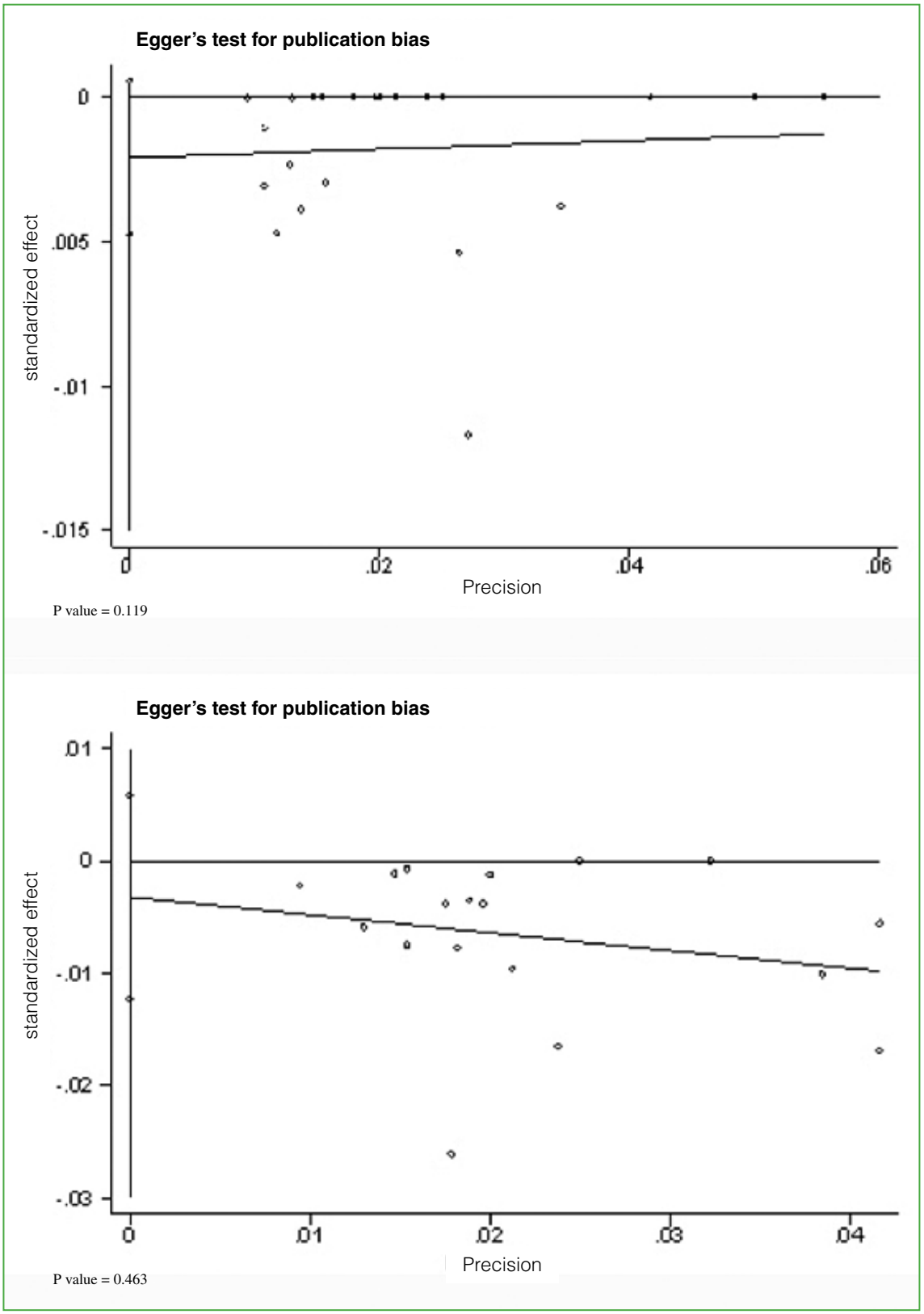

Figure 4. Egger's graph and Egger's test for publication bias.

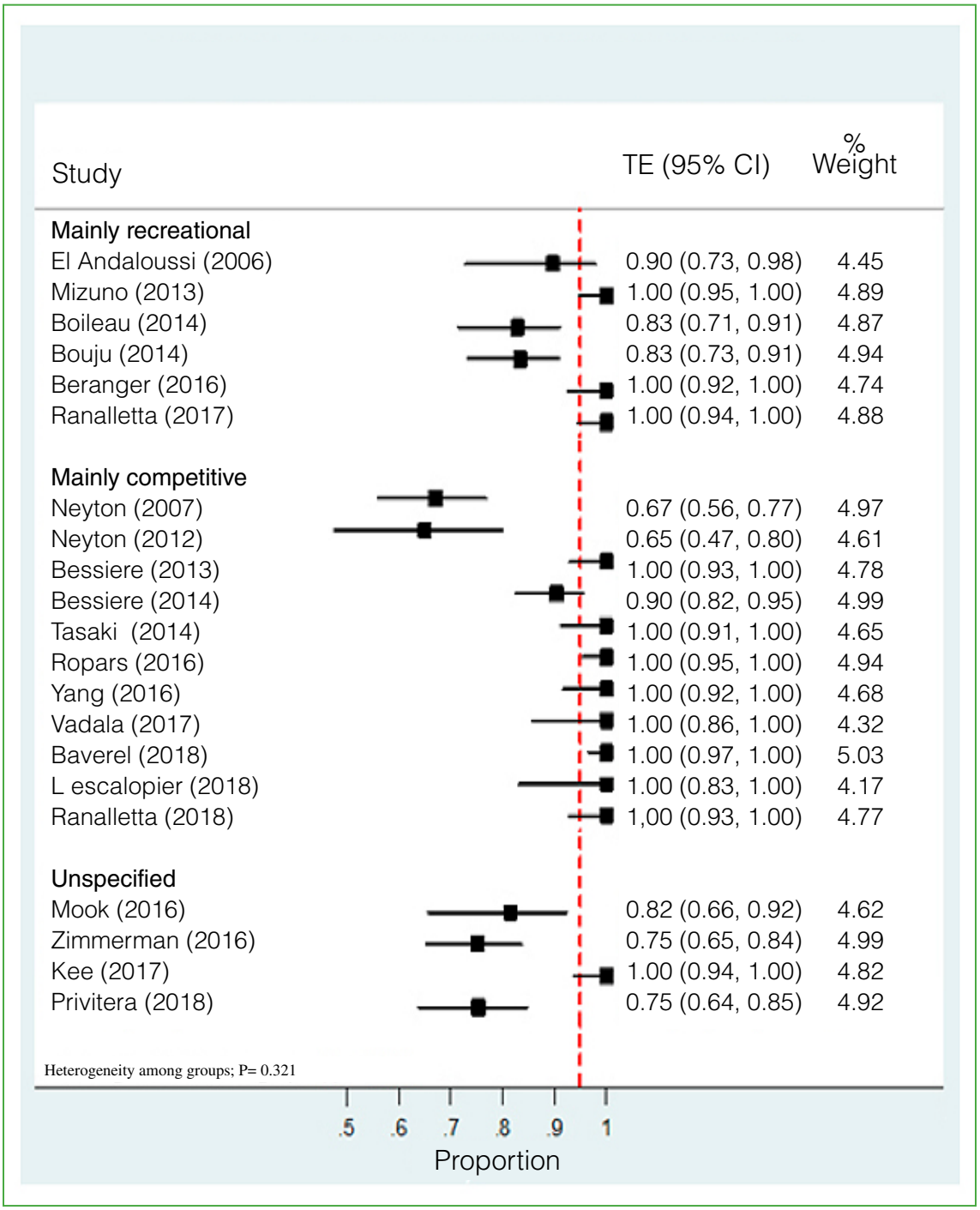

Figure 5. Evaluated subgroup depending on the type of sport.

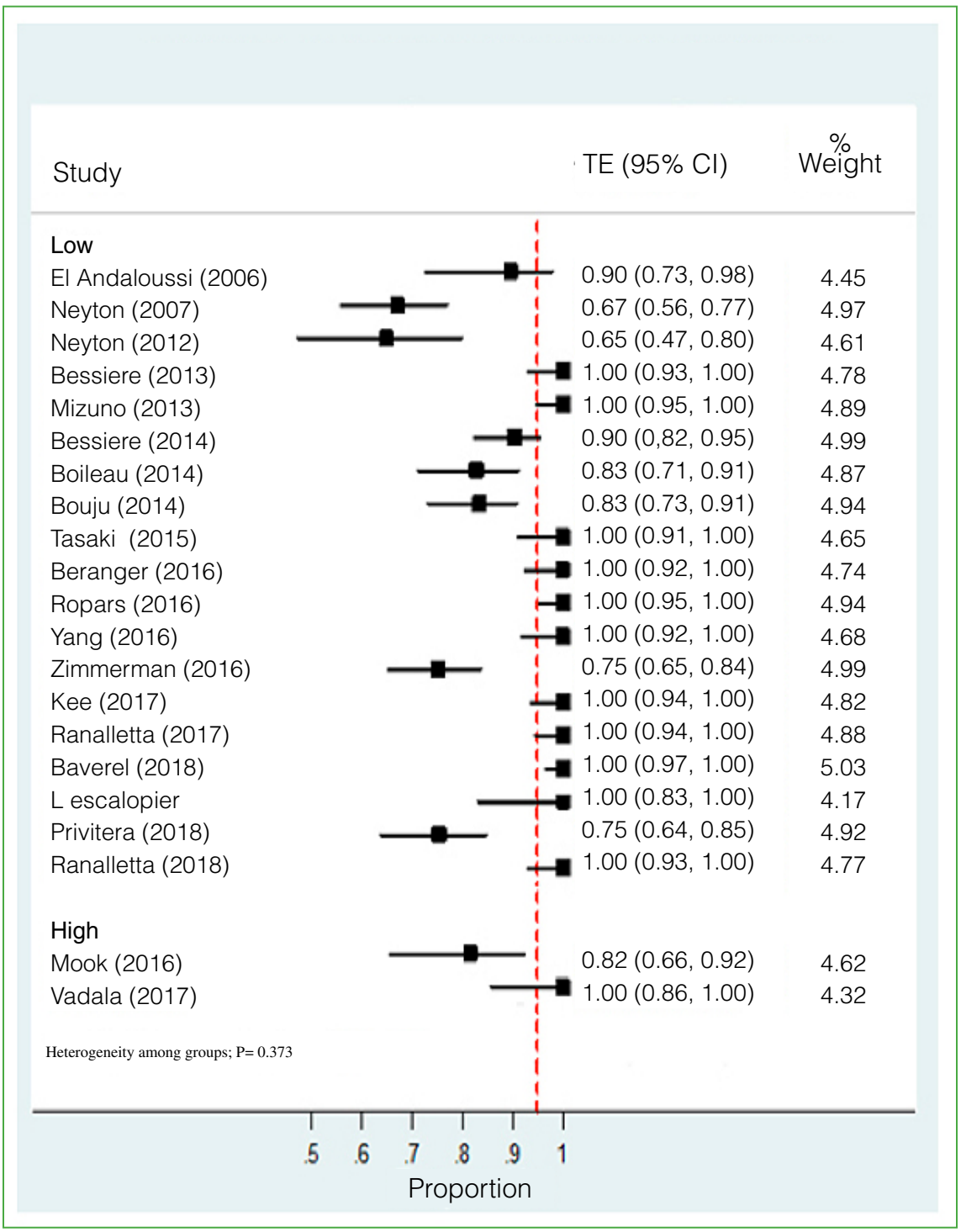

Figure 6. Evaluated subgroup depending on study quality.

Table 3. Summary of the main results of this review using GRADE criteria

Patient or population: Athletes with shoulder instability
Ajustes: Hospitalized patients – Outpatient follow-up; studies from France (14), USA (4), Argentina (2), Italy (2) and Japan (1), Korea (1) and Switzerland (1)
Surgery: Open or arthroscopic Latarjet surgery

Evaluated items	Nº of patients	Evidence certainty (GRADE)	Range of proportion of patients
Return to sports Number of patients who returned to sports after surgery	1197 (23 observational studies)	⊕◯◯◯ Very low [a,b]	65 to 100 every 100 patients
Return to the same sports level *Number of patients who returned to the same sports level**	961 (19 observational studies)	⊕◯◯◯ Very low [a,b]	23 to 100 every 100 patients

*****Within patients who returned to sports**; CI:** Confidence Interval

GRADE Levels of evidence of the studied group
High certainty: We have a lot of confidence that the true effect is similar to the estimated effect.
Moderate certainty: We have moderate confidence on the estimated effect: the true effect is probably close to the estimated effect, but they might be substantially different.
Low certainty: We believe the estimated effect is limited: the true effect might be markedly different from the estimated effect.
Very low certainty: We have very low confidence on the estimated effect: the true effect is probably markedly different from the estimated effect.

Explanations
a. Level 1 is degraded by the studies' limitations: most studies were low-quality.
b. Level 1 is degraded by inconsistence: high statistical heterogeneity of the studies. (>90%)

Complications and postoperative revisions

Seventeen studies reported postoperative complications in 1158 participants. The complications rate ranged from 2% to 31% (Figure 7). The main complications were graft failure (nonunion - fragmentation), screw failure (breakage / intra-articular prominence) and infections. Eleven studies reported revisions in 764 patients.[20, 27, 28, 30-32,38,40-42,46] Few studies reported on the number of revisions, but the most common were due to screw failure (n = 8 /486)[27,30,40,41] and recurrence of instability (n = 4/311).[20,28,31,42,46]

DISCUSSION

The main finding of this study was that, with very low evidence, most athletes with recurrent anterior glenohumeral instability returned to sport; however, the level maintained after shoulder stabilization with Latarjet procedure varied substantially during an average follow-up of 57 months. Moreover, the average time needed to return to sport was 6 months and the results seemed to be equally favorable both in competitive and recreational athletes.

In our study, 65 to 100% of patients were able to return to sport and 23 to 100% returned to the same level of competition as before injury. Curiously, when competitive and recreational athletes were compared, no significant differences regarding return to sport and level of competition achieved were observed. Few authors analyzed the

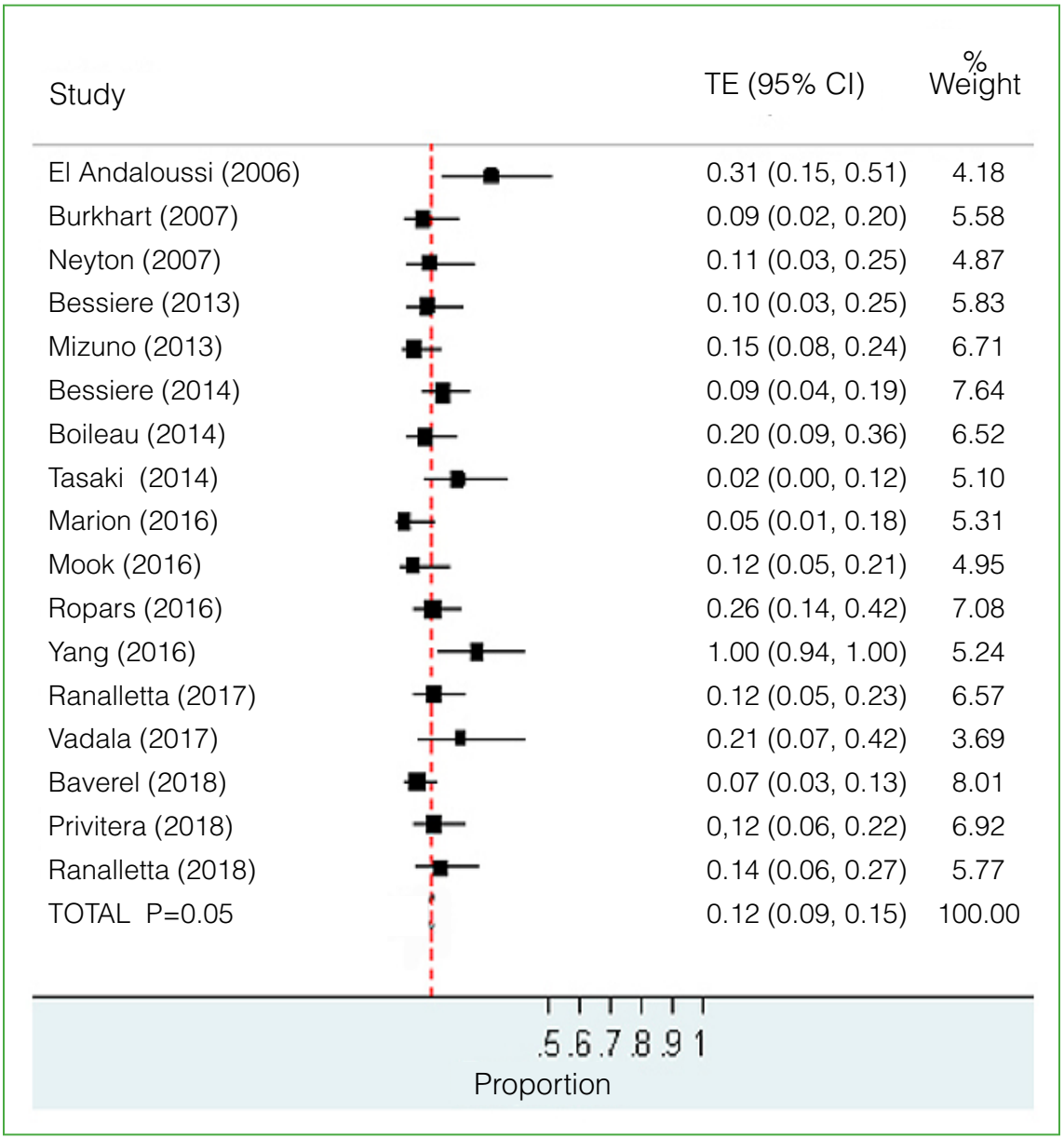

Figure 7. Complications after Latarjet surgery.

results of Latarjet procedure based on the patients' sporting activities. Baverel et al.[20] retrospectively compared 106 patients divided into 2 groups according to their sporting activities: 57 (54%) competitive athletes and 49 (46%) recreational athletes. They found 100% of competitive athletes and 69% of recreational athletes resumed their previous sporting activity. Moreover, 79% of competitive athletes and 43% of recreational athletes achieved the same level as before the injury. The hypothesis was that the difference could be due to the fact that competitive athletes are more disciplined with rehabilitation programs and have better shoulder proprioception and muscle strength. On the other hand, Beranger et al.[35] reported that return to sport after Latarjet procedure for shoulder

stabilization was possible in all competitive and recreational athletes after 6.3 months and 78.7% of patients were able to return to the level of competition they had before the injury. Likewise, other authors reported excellent functional outcomes and high rates of return to sport in recreational athletes.[35,42,47]

The average time to return to sport was 6 months, although the range within each study varied from 1 to 36 months. This proves the lack of consensus among authors regarding the criteria used to allow athletes to return to competition. In a recent systematic review, Ciccoti et al.[48] evaluated the criteria applied to return to sport after a surgical stabilization of traumatic anterior shoulder instability. They identified 13 possible criteria with no consensus among them. Moreover, they found a significant variability among the authors applying said criteria. As an example, "time" was the most widely used criterion applied to allow the return to sport; however, specific time points varied from 1.5 months to 12 months among the different studies. Likewise, a significant limitation of the existing literature is that postoperative protocols are not reported or are briefly described without the methodology needed to replicate them. In our systematic review, none of the studies described a full postoperative rehabilitation protocol, and only five studies[20,30,33,42,47] described the criteria applied for the return to sport beyond a fixed point in time. The moment patients are able to return to unrestricted play after a Latarjet procedure is unclear, and it would be very helpful to create a comprehensive, evidence-based checklist for the return to sport after anterior shoulder stabilization.

Some authors evaluated the relationship between the rates of return to sport and the type of sport. Most studies showed that the rate of return to sport was high even in high-risk sports. Privitera et al.[46] and Ranalletta et al.[47] published the widest series evaluating Latarjet procedure outcomes in contact or collision athletes. The rate of return to sport was 75% and 100% respectively. Other authors also reported high rates of return to sport in collision athletes, ranging between 65% and 97%.[27,28,35,42] The return to sport could be compromised in athletes who perform overhead movements. Berenger et al.[35] reported that patients who performed overhead movements were more likely to play at a lower level or to change sports after surgery.

Only a few studies analyzed the return to sport after a Latarjet procedure as revision of a failed stabilization in athletes. Ranalletta et al.[42] evaluated 68 athletes who underwent a Latarjet procedure for recurrent shoulder instability after a previous failed stabilization surgery. The authors did not find significant differences between primary and revision procedures regarding the return to sport and level of competition achieved by the athletes. However, most patients in the revision group had undergone only 1 previous procedure (average 1.26 procedures). Privitera et al.[46] recently reported Latarjet procedure outcomes for recurrent anterior glenohumeral instability in 73 athletes. Like the previous authors, the researchers found that, at an average follow-up of 52 months, the rate of return to sport was similar when the Latarjet procedure was performed as a primary stabilization procedure (72%) and when it was performed for patients with only 1 previous stabilization procedure (75%). However, for athletes with more than 2 previous stabilization procedures, the rate of return to sport was significantly lower (39%).

Complications associated with the Latarjet procedure, especially in young active patients, are an issue to be considered. The most commonly reported complications include loose grafts, fracture or nonunion of the coracoid graft, recurrence of instability, infection, frozen shoulder, hematoma, neurological complications and arthritis.[49,50] A recent review reported an overall complication rate of 30%.[50] Our study found a complication rate varying from 2 to 31%. Specifically regarding recurrences, the Latarjet procedure seems sufficient to achieve the necessary stability in patients with recurrent glenohumeral instability even in high-demand patients such as contact and collision athletes. In a recent systematic review that evaluated 802 patients in 11 studies, Pereira et al.[51] found an overall recurrence rate of 2,7%, with no significant differences between collision and non-collision sports.

LIMITATIONS

This study has several limitations. First, as with any systematic review, there are studies that could have been missed by our search criteria and the inherent biases of each included study may have influenced our findings. However, we conducted a comprehensive search of multiple databases following a pre-specified protocol for a systematic review, presenting a detailed assessment of risk of bias and specifically highlighting the important limitations of each study to decrease the risk of data misinterpretation. Second, most of the studies included in the analysis were retrospective case series, and thus were affected by the inherent limitations of this type of study.

Third, the details of the surgical techniques and postoperative imaging protocols were not standardized in all studies, which could also be a confounding factor. For example, some authors performed a capsulolabral repair with anchors,[32,34] others only sutured the remnant of the coracoacromial ligament to the anterior capsule[38,28,46] and others did not repair the capsulolabral complex. [42,47]

CONCLUSIONS

The very low-quality evidence indicates that a high percentage of athletes with recurrent anterior glenohumeral instability returned to sport; however, the level maintained after shoulder stabilization with the Latarjet procedure varied substantially. The average time to return to sport was 6 months and the results were equally satisfactory in competitive and recreational athletes.

Conflict of interests: The authors declare they do not have any conflict of interests.

L. Rossi ORCID ID: https://orcid.org/0000-0002-1397-2402
J. V. A. Franco ORCID ID: https://orcid.org/0000-0002-2903-6870
C. Escobar Liquitay ORCID ID: https://orcid.org/0000-0003-0411-899X
I. Pasqualini ORCID ID: https://orcid.org/0000-0002-9551-827X
M. Ranalletta ORCID ID: https://orcid.org/0000-0002-9145-4010

REFERENCES

1. Gowd AK, Liu JN, Cabarcas BC, Garcia GH, Cvetanovich GL, Provencher MT, Verma NN. Management of recurrent anterior shoulder instability with bipolar bone loss: a systematic review to assess critical bone loss amounts. *Am J Sports Med* 2018;27:363546518791555. https://doi.org/10.1177/0363546518791555
2. Willemot LB, Elhassan BT, Verborgt O. Bony reconstruction of the anterior glenoid rim. *J Am Acad Orthop Surg* 2018;26(10):e207-e218. https://doi.org/10.5435/JAAOS-D-16-00649
3. Degen RM, Camp CL, Werner BC, Dines DM, Dines JS. Trends in bone-block augmentation among recently trained orthopaedic surgeons treating anterior shoulder instability. *J Bone Joint Surg Am* 2016;98(13):e56. https://doi.org/10.2106/JBJS.15.01478
4. Rabinowitz J, Friedman R, Eichinger JK. Management of glenoid bone loss with anterior shoulder instability: indications and outcomes. *Curr Rev Musculoskelet Med* 2017;10(4):452-62. https://doi.org/10.1007/s12178-017-9439-y
5. Riff AJ, Frank RM, Sumner S, Friel N, Bach BR Jr, Verma NN, Romeo AA. Trends in shoulder stabilization techniques used in the United States based on a large private-payer database. *Orthop J Sports Med* 2017;5(12):2325967117745511. https://doi.org/10.1177/2325967117745511.
6. Ekhtiari S, Horner NS, Bedi A, Ayeni OR, Khan M. The learning curve for the Latarjet procedure: a systematic review. *Orthop J Sports Med* 2018;6(7):2325967118786930. https://doi.org/10.1177/2325967118786930
7. Dines JS, Dodson CC, McGarry MH, Oh JH, Altchek DW, Lee TQ. Contribution of osseous and muscular stabilizing effects with the Latarjet procedure for anterior instability without glenoid bone loss. *J Shoulder Elbow Surg* 2013;22(12):1689-94. https://doi.org/10.1016/j.jse.2013.02.014
8. Yamamoto N, Muraki T, An KN, Sperling JW, Cofield RH, Itoi E, et al. The stabilizing mechanism of the Latarjet procedure: a cadaveric study. *J Bone Joint Surg Am* 2013;95(15):1390-7. https://doi.org/10.2106/JBJS.L.00777
9. An VV, Sivakumar BS, Phan K, Trantalis J. A systematic review and meta-analysis of clinical and patient-reported outcomes following two procedures for recurrent traumatic anterior instability of the shoulder: Latarjet procedure vs. Bankart repair. *J Shoulder Elbow Surg* 2016;25(5):853-63. https://doi.org/10.1016/j.jse.2015.11.001
10. Lädermann A, Böhm E, Tay E, Scheibel M. Bone-mediated anteroinferior glenohumeral instability : Current concepts. *Orthopade* 2018;47(2):129-38. https://doi.org/10.1007/s00132-017-3511-6
11. Porter DA, Birns M, Hobart SJ, Kowalsky M, Galano GJ. Arthroscopic treatment of osseous instability of the shoulder. *HSS J* 2017;13(3):292-301. https://doi.org/10.1007/s11420-017-9553-9

12. Tjong VK, Devitt BM, Murnaghan ML, Ogilvie-Harris DJ, Theodoropoulos JS. A qualitative investigation of return to sport after arthroscopic Bankart repair: beyond stability. *Am J Sports Med* 2015;43(8):2005-11. https://doi.org/10.1177/0363546515590222
13. Higgins JPT, Lasserson T, Chandler J, Tovey D, Churchill R. Methodological Expectations of Cochrane Intervention [Internet]. London: Cochrane; Version July 2019. Standards for the conduct of new Cochrane Intervention (C1-75). [cited 2019 sept 03]. Disponible en: https://community.cochrane.org/mecir-manual/standards-conduct-new-cochrane-intervention-reviews-c1-75
14. Higgins JPT, Green S. Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Disponible en: www.handbook.cochrane.org
15. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Int J Surg* 2010;8:336-41. https://doi.org/10.1016/j.ijsu.2010.02.007
16. Moga C, Guo B, Schopflocher D, Harstall C. Development of a quality appraisal tool for case series studies using a modified Delphi technique [Internet]. Edmonton AB: Institute of Health Economics; 2012:71 [cited 2019 sept 03]. Disponible en: https://www.ihe.ca/advanced-search/development-of-a-quality-appraisal-tool-for-case-series-studies-using-a-modified-delphi-technique
17. Schünemann H, Brożek J, Guyatt G, Oxman A (eds). Handbook for grading the quality of evidence and the strength of recommendations using the GRADE approach. Updated October 2013 [Internet]. The GRADE Working Group; 2013 [cited 2019 sept 03]. Disponible en: https://gdt.gradepro.org/app/handbook/handbook.html#h.hnedbo8gqjqk
18. El Andaloussi Y, Arssi M, Zaouari T, Benhima MA, Cohen D, Trafeh M, et al. Instabilité antérieure de l'épaule chez les sportifs À propos de 36 cas. *J Traumatol Sport* 2006;23:148-52. https://doi.org/10.1016/S0762-915X(06)71431-0
19. Nyaga VN, Arbyn M, Aerts M. Metaprop: a Stata command to perform meta-analysis of binomial data. *Arch Public Health* 2014;72(1):39. https://doi.org/10.1186/2049-3258-72-39
20. Baverel L, Colle PE, Saffarini M, Anthony Odri G, Barth J. Open Latarjet procedures produce better outcomes in competitive athletes compared with recreational athletes: a clinical comparative study of 106 athletes aged under 30 years. *Am J Sports Med* 2018;46(6):1408-15. https://doi.org/10.1177/0363546518759730
21. Higgins JPT, Green S (eds). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011][Internet]. The Cochrane Collaboration; 2011. Chapter 9, Analysing data and undertaking meta-analyses. [cited 2019 sept 03]. Disponible en: www.handbook.cochrane.org
22. Cote MP, Lubowitz JH, Rossi MJ, Brand JC. Reviews pooling heterogeneous, low-evidence, high-bias data result in incorrect conclusions: but heterogeneity is an opportunity to explore. *Arthroscopy* 2018;34(12):3126-8. https://doi.org/10.1016/j.arthro.2018.10.005
23. Harris JD, Brand JC, Cote MP, Faucett SC, Dhawan A. Research pearls: the significance of statistics and perils of pooling. Part 1: Clinical versus statistical significance. *Arthroscopy* 2017;33(6):1102-12. https://doi.org/10.1016/j.arthro.2017.01.053
24. Hunter JP, Saratzis A, Sutton AJ, Boucher RH, Sayers RD, Bown MJ. In meta-analyses of proportion studies, funnel plots were found to be an inaccurate method of assessing publication bias. *J Clin Epidemiol* 2014;67(8):897-903. https://doi.org/10.1016/j.jclinepi.2014.03.003
25. GRADEpro GDT [Software]. McMaster University and Evidence Prime; c2015 [cited 2019 Sep 03]. Disponible en: gradepro.org
26. Burkhart SS, De Beer JF, Barth JR, Cresswell T, Roberts C, Richards DP. Results of modified Latarjet reconstruction in patients with anteroinferior instability and significant bone loss. *Arthroscopy* 2007;23:1033-41. https://doi.org/10.1016/j.arthro.2007.08.009
27. Neyton L, Dagher E, Jouve F, Josserand LN, Walch G. Chronic anterior glenohumeral instability in rugby player. Series of 85 Latarjet procedures with medium follow-up of seven years. *J Traumatol Sport* 2007;24(3):122-7. https://doi.org/10.1016/j.jts.2007.06.007
28. Neyton L, Young A, Dawidziak B, Visona E, Hager J-P, Fournier Y, et al. Surgical treatment of anterior instability in Rugby Union players: clinical and radiographic results of the Latarjet-Patte procedure with minimum 5-year follow-up. *J Shoulder Elbow Surg*. 2012;21:1721-7. https://doi.org/10.1016/j.jse.2012.01.023
29. Bessiere C, Trojani C, Pélégri C, Carles M, Boileau P. Coracoid bone block versus arthroscopic Bankart repair: a comparative paired study with 5-year follow-up. *Orthop Traumatol Surg Res* 2013;99(2):123-30. https://doi.org/10.1016/j.otsr.2012.12.010
30. Mizuno N, Denard PJ, Raiss P, Melis B, Walch G. Long-term results of the Latarjet procedure for anterior instability of the shoulder. *J Shoulder Elbow Surg* 2014;23(11):1691-9. https://doi.org/10.1016/j.jse.2014.02.015

31. Bessiere C, Trojani C, Carles M, Mehta SS, Boileau P. The open Latarjet procedure is more reliable in terms of shoulder stability than arthroscopic Bankart repair. *Clin Orthop Relat Res* 2014;472(8):2345-51. https://doi.org/10.1007/s11999-014-3550-9
32. Boileau P, Thélu CÉ, Mercier N, Ohl X, Houghton-Clemmey R, Carles M, et al. Arthroscopic Bristow-Latarjet combined with Bankart repair restores shoulder stability in patients with glenoid bone loss. *Clin Orthop Relat Res* 2014;472(8):2413-24. https://doi.org/10.1007/s11999-014-3691-x
33. Bouju Y, Gadéa F, Stanovici J, Moubarak H, Favard L. Shoulder stabilization by modified Latarjet-Patte procedure: results at a minimum 10 years' follow-up, and role in the prevention of osteoarthritis. *Orthop Traumatol Surg Res* 2014;100(4 Suppl): S213-8. https://doi.org/10.1016/j.otsr.2014.03.010
34. Tasaki A, Morita W, Yamakawa A, Nozaki T, Kuroda E, Hoshikawa Y, et al. Combined arthroscopic Bankart repair and coracoid process transfer to anterior glenoid for shoulder dislocation in rugby players: evaluation based on ability to perform sport-specific movements effectively. *Arthroscopy* 2015;31(9):1693-701. https://doi.org/10.1016/j.arthro.2015.03.013
35. Beranger JS, Klouche S, Bauer T, Demoures T, Hardy P. Anterior shoulder stabilization by Bristow-Latarjet procedure in athletes: return-to-sport and functional outcomes at minimum 2-year follow-up. *Eur J Orthop Surg Traumatol* 2016;26:277-82. https://doi.org/10.1007/s00590-016-1751-5
36. Blonna D, Bellato E, Caranzano F, Assom M, Rossi R, Castoldi F. Arthroscopic Bankart repair versus open Bristow-Latarjet for shoulder instability: a matched-pair multicenter study focused on return to sport. *Am J Sports Med* 2016;44(12):3198-3205. https://doi.org/10.1177/0363546516658037
37. Marion B, Klouche S, Deranlot J, Bauer T, Nourissat G, Hardy P. A prospective comparative study of arthroscopic versus mini-open Latarjet procedure with a minimum 2-year follow-up. *Arthroscopy* 2017;33(2):269-77. https://doi.org/10.1016/j.arthro.2016.06.046
38. Mook WR, Petri M, Greenspoon JA, Horan MP, Dornan GJ, Millett PJ. Clinical and anatomic predictors of outcomes after the Latarjet procedure for the treatment of anterior glenohumeral instability with combined glenoid and humeral bone defects. *Am J Sports Med* 2016;44(6):1407-16. https://doi.org/10.1177/0363546516634089
39. Ropars M, Cretual A, Kaila R, Bonan I, Hervé A, Thomazeau H. Diagnosis and treatment of anteroinferior capsular redundancy associated with anterior shoulder instability using an open Latarjet procedure and capsulorrhaphy. *Knee Surg Sports Traumatol Arthrosc* 2016;24(12):3756-64. https://doi.org/10.1007/s00167-015-3621-9
40. Yang JS, Mazzocca AD, Cote MP, Edgar CM, Arciero RA. Recurrent anterior shoulder instability with combined bone loss: treatment and results with the modified Latarjet procedure. *Am J Sports Med* 2016;44(4):922-32. https://doi.org/10.1177/0363546515623929
41. Zimmermann SM, Scheyerer MJ, Farshad M, Catanzaro S, Rahm S, Gerber C.

Long-term restoration of anterior shoulder stability: a retrospective analysis of arthroscopic Bankart repair versus open Latarjet procedure. *J Bone Joint Surg Am* 2016;98(23):1954-61. https://doi.org/10.2106/JBJS.15.01398
42. Ranalletta M, Rossi LA, Bertona A, Tanoira I, Maignon GD, Bongiovanni SL. Modified Latarjet procedure without capsulolabral repair for the treatment of failed previous operative stabilizations in athletes. *Arthroscopy* 2018;34(5):1421-7. https://doi.org/10.1016/j.arthro.2017.12.006
43. Vadalà A, Lanzetti RM, De Carli A, Lupariello D, Guzzini M, Desideri D, et al. Latarjet procedure: evolution of the bone block and correspondent clinical relevance-a clinical and radiological study. *Musculoskelet Surg* 2017;101(Suppl 2):113-20. https://doi.org/10.1007/s12306-017-0482-z
44. Kee YM, Kim JY, Kim HJ, Lim CT, Rhee YG. Return to sports after the Latarjet procedure: high return level of non-collision athletes. *Knee Surg Sports Traumatol Arthrosc* 2018;26(3):919-25. https://doi.org/10.1007/s00167-017-4775-4
45. de l'Escalopier N, Barbier O, Demoures T, Ollat D, Versier G. Long-term results of a monocentric series of soldiers after Latarjet procedure for anterior shoulder instability. Implications for the assessment of soldiers' medical ability. *Mil Med* 2018;183(1-2):e134-e137. https://doi.org/10.1093/milmed/usx040
46. Privitera DM, Sinz NJ, Miller LR, Siegel EJ, Solberg MJ, Daniels SD, et al. Clinical outcomes following the Latarjet procedure in contact and collision athletes. *J Bone Joint Surg Am* 2018;100(6):459-65. https://doi.org/10.2106/JBJS.17.00566
47. Ranalletta M, Rossi LA, Bertona A, Tanoira I, Alonso Hidalgo I, Maignon GD, et al. Modified Latarjet without capsulolabral repair in rugby players with recurrent anterior glenohumeral instability and significant glenoid bone loss. *Am J Sports Med* 2018;46(4):795-800. https://doi.org/10.1177/0363546517749586

48. Ciccotti MC, Syed U, Hoffman R, Abboud JA, Ciccotti MG, Freedman KB. Return to play criteria following surgical stabilization for traumatic anterior shoulder instability: a systematic review. *Arthroscopy* 2018;34(3):903-13. https://doi.org/10.1016/j.arthro.2017.08.293
49. Domos P, Lunini E, Walch G. Contraindications and complications of the Latarjet procedure. *Shoulder Elbow* 2018;10(1):15-24. https://doi.org/10.1177/1758573217728716
50. Griesser MJ, Harris JD, McCoy BW, Hussain WM, Jones MH, Bishop JY, et al. Complications and re-operations after Bristow-Latarjet shoulder stabilization: a systematic review. *J Shoulder Elbow Surg* 2013;22:286-292. https://doi.org/10.1016/j.jse.2012.09.009
51. Paulino Pereira NR, van der Linde JA2, Alkaduhimi H2, Longo UG3, van den Bekerom MPJ. Are collision athletes at a higher risk of re-dislocation after an open Bristow-Latarjet procedure? A systematic review and meta-analysis. *Shoulder Elbow* 2018;10(2):75-86. https://doi.org/10.1177/1758573217728290