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SCIENCE BEHIND SHOULDER INSTABILITY

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SUMMARY

Introduction and aim

The lack of consensus regarding the treatment of first shoulder dislocation, controversies regarding indications for arthroscopic Bankart repair and increasing popularity among shoulder surgeons for bony procedures made us search the literature for what we know and what is still unknown in the treatment of anterior shoulder instability.

Material and methods

The Pubmed, Cochrane and Medline databases were searched for English-language articles published between 2000 and 2017. Papers with highest level of evidence and the most cited ones have been taken into account.

Results

Recent studies have improved our understanding of the pathoanatomy of shoulder instability and thus changed indications and contraindications for different treatment methods. Although best clinical results with the smallest number of recurrence have surgical treatment of first shoulder dislocation, conservative treatment with short time of sling immobilization seems to be the gold standard.

Arthroscopic Bankart repair is currently the most commonly applied surgery for the treatment of anterior shoulder instability. The most important factors influencing good clinical outcome is proper patient selection and in-depth evaluation of both glenoid and

NIESTABILNOŚĆ STAWU RAMIENNEGO- STAN AKTUALNEJ WIEDZY

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STRESZCZENIE

Wprowadzenie i cel pracy

Praca powstała na podstawie dokonanego przeglądu piśmiennictwa, z którego zaczerpnięto informacje dotyczące postępowania z pacjentem po pierwszorazowym zwichnięciu stawu ramiennego, wskazań do artoskopowej naprawy sposobem Bankarta, oraz do zabiegów z użyciem przeszczepów kostnych, jako metod leczenia nawracającego przedniego zwichnięcia stawu ramiennego.

Materiał i metody

Korzystając z wyszukiwarek internetowych: Pubmed, Cochrane i Medline odnaleziono i przeanalizowano artykuły anglojęzyczne opublikowane pomiędzy 2000 i 2017 rokiem dotyczące leczenia przedniej niestabilności barku.

Wyniki

Najnowsze badania pogłębiły naszą wiedzę dotyczącą patomechaniki niestabilności stawu ramiennego i przyczyniły się do indywidualizowania wskazań i doboru metod leczenia. W przypadku pierwszorazowego zwichnięcia stawu ramiennego złotym standardem pozostaje leczenie zachowawcze z krótkotrwałym unieruchomieniem chorej kończyny w temblaku. Jednakże leczenie operacyjne, jako skuteczniejsze w kontekście nawrotów niestabilności należy rozważyć np. w przypadku wyczynowych sportowców.

Artroskopwa naprawa przedniego kompleksu więzadłowo-obrąbkowego pozostaje metodą „z wyboru" w przewlekłej przedniej niestabilności stawu ramiennego. Najważniejszym czynnikiem decydującym o wyniku leczenia jest obecność uszkodzeń kostnych

humeral bone loss. Other relevant factors affecting the success of the Bankart repair include technical issues.

In cases of significant bone loss the most effective surgical procedures are Latarjet and bone block surgery. Numerous biomechanical studies explain stabilizing mechanisms of these methods and describe important technical issues influencing the outcomes.

Conclusions
Although more and more clinical and biomechanical studies are published, controversies regarding the treatment of shoulder instability remain and further investigations are needed.

Keywords: shoulder instability, clinical studies, biomechanics studies

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w postaci złamania typu Hill-Sachs, lub ubytku fragmentu przedniego brzegu panewki.

W takich przypadkach najskuteczniejszymi metodami leczenia są zabiegi z użyciem przeszczepów kostnych, np. zabieg sposobem Latarjet.

Wnioski
Pomimo licznych badań klinicznych i biomechanicznych dotyczących leczenia przedniej niestabilności stawu ramiennego wiele kontrowersji pozostaje bez odpowiedzi, co sugeruje zasadność prowadzenia dalszych badań.

Słowa kluczowe: niestabilność barku, badania kliniczne, badania biomechaniczne

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Introduction and aim
Anterior shoulder dislocation is the most common joint dislocation seen in an emergency department (Pope *et al.,* 2011). The high risk of recurrence, especially among young population, makes it one of the major challenges for shoulder surgeons. The lack of consensus regarding the treatment of the first shoulder dislocation, controversies about indications for arthroscopic Bankart repair and increasing popularity of bony procedures made us search the literature for what we know and what is still unknown in the treatment of anterior shoulder instability. The aim of the study is to summarize the current knowledge regarding this common issue.

Materials and methods
The Pubmed, Cochrane and Medline databases were searched for English-language articles published between 2000 and 2018. Articles were identified by means of an electronic search for keyword terms and their various combinations. The search terms included „shoulder dislocation", "anterior shoulder instability", "first-time dislocator", "arthroscopic Bankart", "Latarjet" and "bone block". Papers with the highest level of evidence and the most cited ones have been taken into account.

Results
Treatment of the first traumatic dislocation
Restoration of a stable, pain-free and functioning shoulder is the main treatment goal after the first episode of dislocation. The management includes closed reduction of acute dislocation followed by conservative or surgical treatment.

Conservative treatment, which is generally preferred, consists of short period of rest, involving immobilization of the arm in a sling and subsequent rehabilitation programme. Numerous conservative strategies may be accepted, and many warrant investigations. The evidence from randomized

controlled trials is only available for one issue: immobilization in external rotation versus immobilization in the traditional position of internal rotation. Moreover, this evidence is insufficient to demonstrate which strategy is more beneficial. Casting of the arm in external rotation has been propagated by Liavaag and Itoi (Itoi *et al.,* 2007; Liavaag *et al.,* 2009). They have suggested that this strategy could reduce the labrum back to a more anatomical position. Other authors (Finestone *et al.,* 2009; Hanchard *et al.,* 2014; Hhg *et al.,* 2009) have reported no significant differences in terms of return to sports and dislocation recurrence rate between these two methods. We have found no well-powered trials analyzing other aspects of conservative treatment including the optimum duration of immobilization, whether immobilization is necessary at all (in older age groups particularly), or which rehabilitative interventions work best in patients with first shoulder dislocation.

Surgical treatment, depending on the size of destruction, may involve both soft-tissue and bony procedures. Although the literature remains unclear about the best solution for the first-time dislocators, the limited evidence available supports primary surgery for young adults, usually male, engaged in demanding physical activities, who are at high risk of recurrent instability (Handoll *et al.,* 2004; Owens *et al.,* 2010, 2007). Redislocation rates in this specific group of patients have been reported to be as high as 90% after non-operative treatment (Aboalata *et al.,* 2017). There is no evidence available to determine whether non-surgical treatment should or should not remain the prime treatment option for other categories of patient. A systematic review published in 2010 (Grumet *et al.,* 2010) reported no differences in dislocation recurrence or complication rate among patients undergoing surgery after the primary dislocation when compared with those undergoing surgery after multiple recurrent episodes. Admittedly the studies included in the review were not entirely comparable regarding different surgical techniques and rehabilitation protocols. Results of a very recently published multicenter analysis from MOON Shoulder Instability Group (Rugg *et al.,* 2018) show that first-time shoulder dislocators who undergo stabilization are more likely to undergo an arthroscopic procedure and less likely to have bone loss or biceps pathology compared with recurrent dislocators.

Treatment of recurrent instability- Bankart repair

Arthroscopic Bankart repair is currently the most commonly applied surgery for the treatment of anterior shoulder instability (DeFroda *et al.,* 2017). The goal of this procedure is to restore stability of the joint by reattaching the avulsed anterior capsulo-labral complex to the glenoid rim. In patients with a high risk of recurrent instability or who have failed conservative treatment, artrhroscopic Bankart repair is the stabilization technique of choice.

Recent studies have improved our understanding of the pathoanatomy of shoulder instability and thus, changed indications and contraindications for the arthroscopic Bankart repair. These studies have shown that the most important factors influencing good clinical outcome is proper patient selection and in-depth evaluation of both glenoid and humeral bone loss (Balg and Boileau, 2007; DeFroda *et al.,* 2017). Other relevant factors affecting the success of the Bankart repair include technical issues like patient positioning (beach chair versus lateral decubitus), adding adjuvant surgical procedures (remplissage), types and number of utilized suture anchors, or types of the construct (single or double row repair).

Many different authors have focused on defining critical glenoid bone loss that would be safe for Bankart repair without bony procedures. Burkhart first classified significant bone loss as having an “inverted-pear” glenoid, in which enough anterior-inferior bone is lost for the glenoid to assume the shape

of a pear. Recurrent instability occurred in 61.1% of patients treated with Bankart repair with inverted-pear-shaped glenoids (Aboalata *et al.,* 2017). Shaha *et al.* concluded their study that the threshold for glenoid bone loss treated solely with Bankart repair should be defined as value less than 15%, especially in highly active patients (Shaha *et al.,* 2015). According to Dickens *et al.* arthroscopic Bankart repair was a reliable procedure in American football players with up to 13.5% of glenoid bone loss. Shin *et al.* redefined the critical bone loss as 17.3% (Aboalata *et al.,* 2017). The results of the mentioned studies reveal that the consensus does not exist and the treatment of patients from the grey zone should be individualized based on patient's activity level, goals and expectations.

Another important aspect influencing the outcome of Bankart repair is the presence of Hill-Sachs lesion. Wolf *et al.* investigated the repair of engaging Hill-Sachs lesions in patients with less than 25% glenoid bone loss. Filling the lesion via remplissage technique significantly reduced the incidence of redislocation (Wolf and Arianjam, 2014). Itoi and associates introduced the concept of the "glenoid track." Using 3D CT scans, they identified bipolar bone losses that, interacting in different dynamic patterns in abduction and external rotation, may be not suitable for Bankart repair and could require treatment with bone graft (Yamamoto *et al.,* 2007). Locher *et al.* analyzed redislocation rate in patients with off- versus on-track bipolar lesions. Only 6% of patients from the on-track group, comparing to 33% from the off-track group, experienced recurrent instability, requiring revision surgery (Aboalata *et al.,* 2017).

Timing of the surgery is another valid factor affecting the results of the Bankart procedure. Regardless of the indications used, repair is more effective when performed early after injury. Patients with greater number of dislocations prior to intervention are both more likely to have injury to their glenoid cartilage and more frequently have high-grade glenoid bone loss. Once decision about surgical treatment is made, the repair should not be postponed (Dumont *et al.,* 2011; Krych *et al.,* 2015; Sugaya *et al.,* 2003).

Another subject of dispute regarding the arthroscopic Bankart repair may be patients positioning. In the systemic review by Frank et al,(Frank *et al.,* 2014) lower redislocation rates were found in patients operated in lateral decubitus when compared to beach chair position. No differences in terms of functional outcome and return to sport were noted.

When it comes to surgical technique, authors have particularly focused on the method of fixation of the Bankart lesions. Nho *et al.* (2010) in their biomechanical analysis examined differences between repairs with simple stitch, suture anchor with horizontal mattress stitch, double-loaded suture anchor with simple stitch, and knotless suture anchors. When moderate cyclical load was applied all four constructs have proven to be strong enough. The knotless device, however exhibited significantly less force to ultimate failure, while the other three constructs performed similarly. This might be important to consider when performing Bankart repair on contact athletes.

Additionally, it is important to consider the number of suture anchors used for the construct. Boileau *et al.* have found higher instability recurrence rates in repairs, in which less than four anchors were used (Boileau *et al.,* 2006). Subsequently, this finding has been confirmed by Shibata *et al.* (2014).

Many authors argue whether single or double row repair should be the method of choice. The supporters of the double row technique argue that full release and fixation of the labrum to the articular edge only, does not facilitate healing and alters the native anatomy of the capsuolabral complex (Ahmad *et al.,* 2009; Lafosse *et al.,* 2006; Moran *et al.,* 2014). Moran *et al.* recommend double row repair in patients with recurrent instability and in high-risk first dislocators

(males under age 25, contact athletes) (Moran *et al.,* 2014).

Treatment of recurrent instability- bony procedures

In cases of large glenoid bone loss and Hill-Sachs lesions failure rate of soft tissue repair reaches 67%. Biomechanical studies show that bony defect which reaches up to 21–27% of glenoid width or Hill-Sachs lesion that engages anterior rim of the glenoid in ABER position are the defects that should be addressed with other than soft tissue repair procedure (Itoi *et al.,* 2000; Lo *et al.,* 2004). The most effective ones are Latarjet and bone block procedures (iliac crest, distal tibia). The main factors influencing the outcome of the surgery are: graft position and graft healing (Hovelius *et al.,* 2012; Kordasiewicz *et al.,* 2017; Mizuno *et al.,* 2014). Recent studies however suggest that graft resorption and the lack of healing do not influence clinical and functional results after Latarjet surgery (Vadalà *et al.,* 2017). The probable reason explaining this phenomenon is that, according to the literature, the main stabilizing mechanism of this procedure is the sling effect of the conjoint tendon (Yamamoto *et al.,* 2010). Kephart *et al.* (2014) have come to the same conclusion in their biomechanical study comparing soft-tissue Bristow with bone block Bristow procedure. There were no differences regarding instability recurrence between these two techniques.

The most popular fixation method of bone graft is screw fixation. All the common screw types sustain physiological shear loads (Willemot *et al.,* 2018). The mechanical properties of uni- and bicortical fixation seem to be the same. Nevertheless, 6.5% of failure rate, bone graft osteolysis and complications due to hardware failure causing soft tissue irritation lead to search for other methods of fixation. This is why suture button fixation is gaining popularity among shoulder surgeons. It has no complications characteristic for screw fixation and graft union rate is 83%, very similar as with screws (Gendre *et al.,* 2016). In case series papers Latarjet procedure seems to be very effective with redislocation rate about 3%. Overall complications rate reaches 10.6–30%. These were: wound infections, superficial vein thrombosis, musculocutaneous neuropraxia, graft nonunion, graft malunion, graft migration and hardware loosening (Griesser *et al.,* 2013).

Literature lacks well-powered clinical studies with long-term follow-up regarding other bone block procedures. Recently published case series show a high rate of recurrence and complications in high demanding group of patients (Waterman *et al.,* 2016).

Conclusions

Although more and more clinical and biomechanical studies are published, controversies regarding the treatment of both first-time shoulder dislocation and recurrent instability remain and therefore further investigations are needed.

In spite of the fact that numerous studies show better clinical results, with the smallest number of recurrence, of the surgical treatment of first shoulder dislocation, conservative treatment with short time of sling immobilization seems to be the gold standard. Even though more than 50% of first-dislocators at the age of 40 years or younger will experience recurrent instability, treating all patients surgically is almost certainly overtreatment (Hovelius and Rahme, 2016). *The best treatment option should be always individualized and honestly discussed with the patient, keeping focus on their needs and potential risk factors for recurrent dislocation.*

Arthroscopic Bankart repair, when performed for the correct indications, shall be regarded as a safe and effective treatment option, with a lower complication rate when compared to open procedure (Owens *et al.,* 2011). Reported complications include anchors pull-out, stiffness, infection, nerve injury, and osteoarthritis (Dhawan *et al.,* 2012; Harris *et al.,* 2013; Owens *et al.,* 2011).

Recurrence of shoulder instability has been reported to range from 3.4 to 33.3%, with an average rate of 13.1% (DeFroda *et al.,* 2017). Return to previous level of work ranges from 46 to 97%, with an average rate of 70.7% (DeFroda *et al.,* 2017). Overall long-term patient satisfaction is above 90% (DeFroda *et al.,* 2017).

Glenoid bone loss is known to be an important cause of recurrent anterior shoulder instability. Advanced imaging technology has led to improved methods for diagnosing and accurately quantifying glenoid bone loss for surgical planning. While the Latarjet procedure remains the gold standard, new techniques occur. In the subset of patients with failed Latarjet or large amount of bone loss, either the iliac crest bone grafting or distal tibia allograft can be used as reconstruction options. Despite the significant graft resorption rates seen with the Latarjet procedure and bone grafting, functional outcome and recurrence rate is good to excellent in majority of patients. Continued research is required to identify a universally accepted method for evaluating glenoid bone loss, and to identify surgical techniques, grafts, and stabilization types that bring the best reconstruction results.

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