

Ehlers-Danlos syndrome and shoulder instability: current surgical strategies and future directions

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Abstract

Ehlers-Danlos syndromes (EDS) are complex connective tissue disorders, with hypermobile EDS (hEDS) being the most common subtype, characterised by joint hypermobility. Diagnosis relies primarily on clinical assessment and family history, as definitive genetic testing is not yet available. Patients with hEDS frequently experience shoulder instability, often involving bidirectional patterns, posing substantial management challenges.

Conservative management remains the cornerstone of treatment for hEDS-related shoulder instability. Evidence supports structured, progressive physiotherapy programmes that emphasise strengthening of dynamic stabilisers, including higher-load exercise where tolerated, alongside neuromuscular and proprioceptive training. Progressive home-based programmes with monitoring and selective adjunctive interventions, such as compression garments and taping for short-term improvements in pain or range of motion, have demonstrated feasibility and potential benefit, enhancing accessibility and long-term adherence.

Surgical interventions, including arthroscopic techniques such as posterior glenohumeral capsular reconstruction with allografts, and open procedures such as inferior capsular shift or shoulder arthroplasty, have shown promise in carefully selected patients. Long-term outcomes remain limited, and surgical decision-making should be individualised, performed in specialised centres, and integrated with structured postoperative rehabilitation.

This narrative review summarises and compares available surgical options and evaluates current evidence supporting conservative management for shoulder instability in hEDS.

Key words: orthopaedic surgery, Ehlers-Danlos syndrome, shoulder instability, musculoskeletal treatment, joint hypermobility.

Introduction

Ehlers-Danlos syndromes (EDS) are multisystemic heritable connective tissue disorders that predominantly affect women [1–4]. Historically considered rare, their prevalence was estimated at 1 in 5,000 individuals [5]. However, recent epidemiological studies suggest a higher-than-expected incidence, with Demmler et al. [2] re-

porting roughly 10 cases per 5,000 patients, indicating that EDS may be underdiagnosed in clinical practice.

The first comprehensive description of EDS dates to Tschernogobow in 1892 [6]. Subsequently, further observations were reported by 2 dermatologists – Ehlers in 1901 [7] and Danlos in 1908 [8]. While the early studies primarily focused on joint hypermobility and connective

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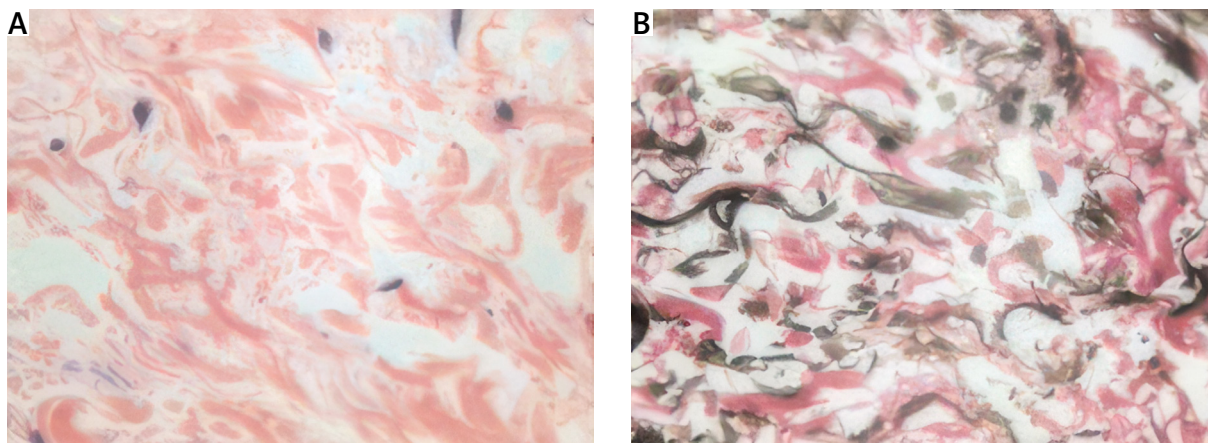


Fig. 1. Ehlers-Danlos syndrome (EDS) exemplar, classical EDS. A) Light microscopy showing loosely arranged collagen fibres without regular bundle formation in the reticular dermis (HE $\times 400$). B) Elastic fibres present in normal quantities but with irregular distribution (Verhoeff $\times 400$). Courtesy of Hiram Larangeira de Almeida Jr [9].

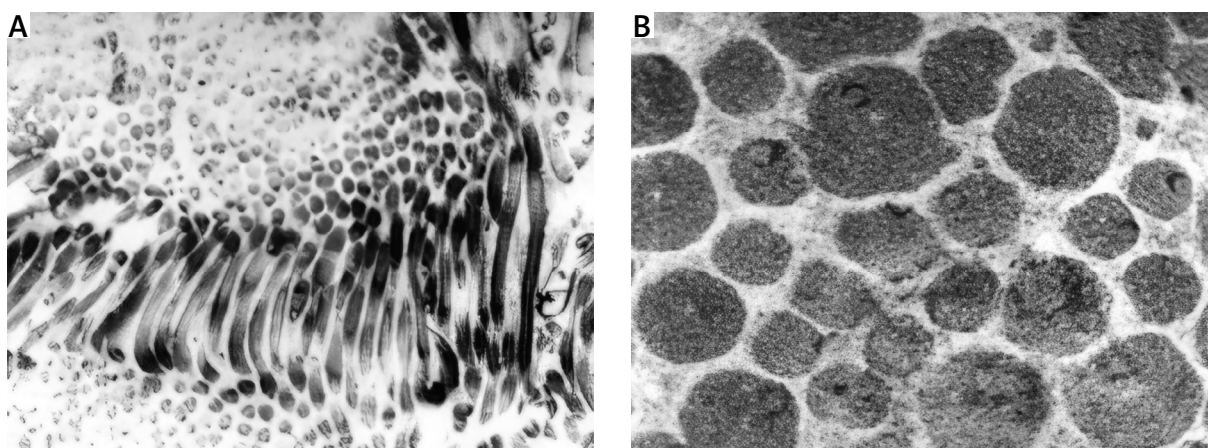


Fig. 2. Ehlers-Danlos syndrome (EDS) exemplar, classical EDS. Transmission electron microscopy. A) Disorganised collagen fibres observed in cross-sectional and longitudinal views ($\times 12,000$). B) Collagen fibres with varying diameters and irregular outlines ($\times 85,000$). Courtesy of Hiram Larangeira de Almeida Jr [9].

tissue fragility, rapid advances in genetics have allowed numerous types of EDS to be distinguished.

In parallel with advances in genetics, the nomenclature of EDS has evolved. In March 2017, the Ehlers-Danlos Society introduced an updated classification system defining thirteen EDS subtypes, each characterised by distinct clinical and genetic features [3]. Moreover, the histological presentation of EDS was also thoroughly studied, and it may be considered a valuable addition in the diagnostic process of EDS. The histological changes are presented in Figures 1–3 [9]. Given that high-quality human histologic and ultrastructural imaging is rarely available in the hypermobile EDS (hEDS) surgical literature, Figures 1–3 provide a representative connective-tissue microarchitecture from classical EDS (cEDS) as a genetically defined EDS exemplar. These figures

are illustrative, as the collagen/extracellular matrix disorganization shown provides mechanistic context for the shared, clinically relevant phenotype across the hypermobility spectrum, i.e. capsuloligamentous laxity and tissue deformation under load. It may plausibly influence tissue handling during surgery, fixation strength, and the tendency for repairs to “stretch out” over time in hEDS-related shoulder instability.

Among them, the most common type is hEDS [5]. It is characterised by generalised joint hypermobility, musculoskeletal complications, and systemic manifestations of connective tissue dysfunction, without the presence of significant skin fragility. Understandably, the diagnostic criteria include at least 1 first-degree relative meeting hEDS criteria [10]. Regarding the shoulder joint, the main symptoms are subluxation or joint dislo-

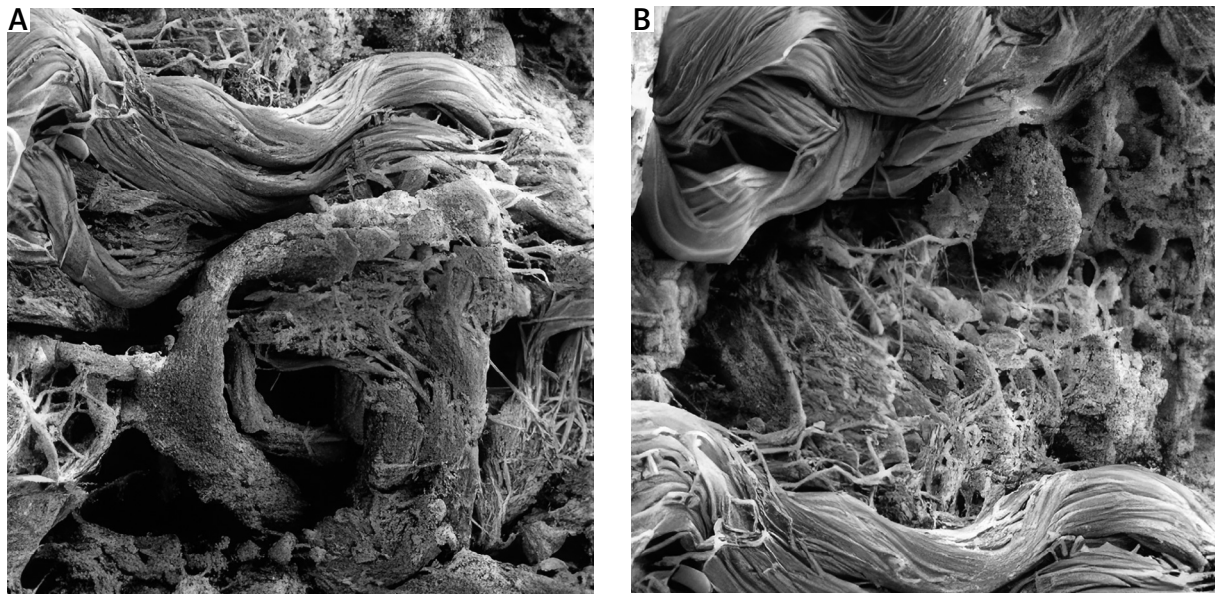


Fig. 3. Ehlers-Danlos syndrome (EDS) exemplar, classical EDS. Scanning electron microscopy showing irregular distribution of dermal collagen fibres, with some arranged in bundles and some isolated ($\times 3,600$). Courtesy of Hiram Larangeira de Almeida Jr [9].

cation [10], and increased shoulder pain [11]. Unlike other EDS subtypes, no specific genetic test exists for hEDS, making clinical evaluation and family history critical for diagnosis [3]. Among hEDS patients, shoulder instability is one of the most prevalent and disabling symptoms. Bo Song et al. [4] reported that 78% of hEDS patients had experienced shoulder-related issues, such as recurrent subluxation, dislocation, pain, and functional impairment. The underlying connective tissue dysfunction leads to impaired shoulder function [10, 11], which might complicate both conservative and surgical treatment approaches.

While EDS is often treated conservatively, patients with chronic instability and functional limitations may require surgical intervention. However, early research reported high failure rates and poor long-term outcomes in surgical treatments for EDS-related shoulder instability [1, 12]. Conversely, a 2024 retrospective study found that surgical intervention can provide significant functional benefits for patients with non-vascular EDS, reinforcing the role of individualised surgical approaches [13]. In addition, some authors have suggested shoulder arthrodesis as an end-stage salvage procedure, given the difficulty in achieving long-lasting stability [14, 15]. More recently, interest in minimally invasive surgical treatment of EDS has increased. A 2024 study analysing surgical trends in EDS-related shoulder instability reported a growing preference for minimally invasive procedures, highlighting the potential for improved outcomes with emerging arthroscopic methods [16].

Given the rapid evolution of operative techniques and the increasing number of related publications over the past decade, this narrative review aims to critically summarise and compare current surgical approaches, with particular emphasis on surgical indications, clinical outcomes, and differences between open and arthroscopic techniques.

Material and methods

Two independent researchers screened and selected articles published in 2012 or later by browsing medical databases (PubMed and Cochrane) using phrases such as “Ehlers-Danlos syndrome instability shoulder”, “Ehlers-Danlos syndrome shoulder”, “Ehlers-Danlos shoulder multidirectional”, and others. Following the database search, 39 articles were identified. Reference lists of these were then screened manually, yielding an additional 4 potential studies to be included (total $n = 43$). No duplicates were found. Next the researchers familiarised themselves with the 43 abstracts. As a result, 34 articles were excluded. The remaining 9 were fully assessed for eligibility. Four more papers were excluded, as these were technical notes without any measurable outcomes. The core outcome evidence set numbered 5 articles: 2 outcome studies and 3 technical notes/case reports with results or follow-ups. Thus, core evidence set articles met the inclusion criteria, i.e. original publication (including case reports) describing surgical management of shoulder EDS patients with results. Figure 4 presents a PRISMA-style flowchart of literature selec-

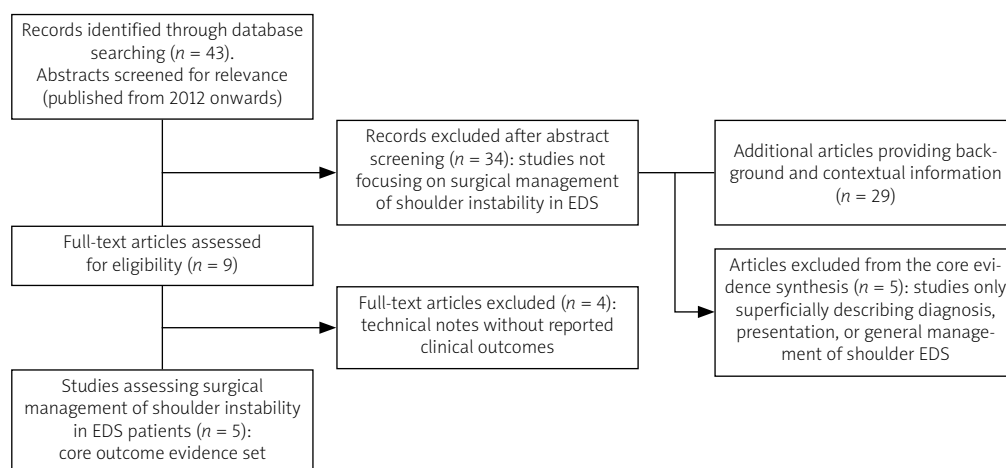


Fig. 4. PRISMA-style flowchart presenting the selection of literature for this narrative review.

EDS – Ehlers-Danlos syndrome.

tion for this narrative review. Even though the majority of primarily selected articles did not meet the inclusion criteria, they present a significant contribution to our synthesis as an expanded context and descriptive background ($n = 29$). We also considered the “Journal of Bone and Joint Surgery” (JBJS) level of evidence (I–V) for the 9 articles fully assessed for eligibility and presented summaries of their content in Table I.

Surgical management alternatives of shoulder Ehlers-Danlos syndrome

Given the complexities of shoulder instability in EDS and the historically high failure rates of surgical interventions, advancements in surgical techniques have sparked renewed interest in their potential effectiveness.

While conservative management remains the first-line approach, recent innovations in both arthroscopic and open procedures offer promising alternatives for patients with persistent instability. The following sections explore these evolving surgical strategies, their benefits, limitations, and the latest clinical insights shaping the future of EDS-related shoulder surgery. Furthermore, Table I summarises the most recent developments in the surgical management of EDS patients. Although not every study in Table I reports clinical outcomes, several provide detailed descriptions of surgical techniques that are highly relevant to the topic of shoulder EDS surgical management.

Arthroscopic management of patients with shoulder instability – a current perspective

Surgical management is particularly demanding in patients suffering from connective tissue disorders, and there is a need for a breakthrough in the surgical techniques.

In 2018 Karpyshyn et al. [17] described a technique for reconstruction of the posterior glenohumeral capsule using an acellular dermal allograft in treatment of posterior instability in EDS and a previously failed plication. The same type of allograft was used according to Gallagher et al. [18], who found the anterior capsule augmentation and posterior glenohumeral capsular reconstruction with human dermal allograft to be a viable procedure in multidirectional shoulder instability, which includes EDS. Even though there are many options in surgical treatment of shoulder instability in EDS, the alternatives are limited for patients who have soft tissue pathology and have failed primary repair (the failure rate is approximately 3–25% in early clinical studies and 6–7% at an average of 36 months after the operation). It is due to the poor quality of the tissue, which is the main challenge for the operator [17]. Both methods using dermal allograft present advantages and disadvantages. Arthroscopy, as a minimally invasive procedure, in combination with dermal allograft augmentation, minimises donor-site morbidity, preserves native anatomy, and allows the use of allograft tissue in patients with connective tissue disorders (e.g. EDS). Compared to open surgical techniques, it shows lower postoperative pain, higher postoperative range of motion (ROM), and improved recovery time [17, 18]. Since it is hypothesised that acellular dermal allograft imitates the anatomical anterior capsule, it successfully absorbs into the native capsule. Its application in multiple procedures, such as superior capsular reconstruction and open reconstruction of the anterior capsule, was found to be effective in shoulder instability [18–21]. However, it is not without limitations. It has been pointed out that in specific cases (e.g. glenoid retroversion, scapular dyskinesia or volitional dislocations) it might not be an ideal treatment method [17]. The aforementioned techniques require substantial

Table I. Key publications included in this narrative review of surgical management of shoulder instability in Ehlers-Danlos syndrome

Title	Year	Procedure	JBJS level of evidence	Shoulders (n)	Complications
<i>Bilateral Anterior and Posterior Glenohumeral Stabilization Using Achilles Tendon Allograft Augmentation in a Patient with EDS[†]</i>	2012	Bilateral anterior and posterior glenohumeral stabilization utilizing Achilles tendon allograft	V	1	No complications after short-term follow-up (after 4 months to 3 years)
<i>Shoulder Arthroplasty is a Viable Option in Patients with EDS[†]</i>	2021	Shoulder arthroplasty: – 6 total shoulder arthroplasties – 4 reverse shoulder arthroplasties	III	10	The differences in complication rates of shoulder arthroplasty in EDS compared to patients with other diagnoses were not statistically significant. However, 2 of 10 patients (20%) sustained postoperative instability
<i>Arthroscopic Capsular Plication for Multidirectional Shoulder Instability in Hypermobile EDS Patients*</i>	2021	Arthroscopic capsular plication	V	1	Long-term clinical outcome studies are currently unavailable
<i>Arthroscopic Anterior and Posterior Glenoid Bone Augmentation with Capsular Plication for EDS With Multidirectional Instability*</i>	2018	Solely arthroscopic technique involving extra-articular anterior and posterior glenoid bone grafting (either distal tibial allograft or iliac crest autograft)	V	1	No studies with clinical outcomes are currently available for this technique
<i>Anterior Capsule Augmentation and Posterior Glenohumeral Capsular Reconstruction with Human Dermal Allograft for Multidirectional Shoulder Instability*</i>	2020	Anterior and posterior capsular plication with extra-articular glenoid bone grafting (distal tibial allograft or iliac crest autograft)	V	1	No studies with clinical outcomes are currently available for this technique
<i>Posterior Glenohumeral Capsular Reconstruction Using an Acellular Dermal Allograft*</i>	2018	Anterior capsule augmentation and posterior glenohumeral capsular reconstruction with a human dermal allograft	V	1	Long-term clinical outcome studies are currently unavailable
<i>Open Inferior Capsular Shift for Multidirectional Shoulder Instability in Adolescents with Generalized Ligamentous Hyperlaxity or EDS[†]</i>	2016	Open inferior capsular shift for atraumatic shoulder instability	IV	15	7 patients with recurring subluxation, 1 patient reported instability, 1 perioperative incident: reflex sympathetic dystrophy; at final follow-up, no patient had subscapularis dysfunction
<i>Shoulder Arthrodesis*</i>	2018	Shoulder arthrodesis	V	1	Improved functional range of motion: the patient was able to reach her head and lumbar spine through scapulothoracic motion
<i>Dynamically Rebalancing the Unstable Shoulder in Ehlers-Danlos Syndrome: Latissimus Dorsi Transfer for Posterior Shoulder Instability[†]</i>	2024	<i>Latissimus dorsi</i> transfer	V	1	Improved shoulder stability. At 24-month follow-up, posterior subluxation with glenoid retroversion occurred in the contralateral shoulder. The treated shoulder showed concentric reduction at 31-month follow-up without pain

*Technical note.

[†]Studies with outcomes.

arthroscopic skill, making the learning curve steep and demanding. Furthermore, the high cost of the dermal allograft and potentially long time of the operation are critical factors to consider. All in all, these techniques were considered acceptable for surgical management of patients with both multidirectional shoulder instability and EDS patients with failed primary repair. However, we should remember that the long-term outcomes are still unknown and need to be further investigated [17, 18].

The latest technical note regarding surgical management of unstable shoulders was published by Housset et al. [22] and presented the arthroscopic capsular plication for multidirectional shoulder instability in hEDS patients. They indicate that the surgery itself presents exceptional technical challenges in hEDS patients [22]. The majority of patients with hEDS are young and active people who have failed conventional surgical management of the condition [23]. The aim of this procedure is to enhance proprioception by performing a global volume reduction of the glenohumeral joint, which could eventually maximise the effects of postoperative rehabilitation. This sensorimotor rationale parallels conservative proprioceptive strategies used in hEDS (e.g., kinesiology taping and compression garments to augment afferent feedback) [24, 25]. These reports support capsular plication as a potential adjunct to, rather than a replacement for, structured proprioceptive rehabilitation.

Moreover, the arthroscopic capsular plication seems promising, as it has reduced invasiveness compared to open procedures, allows for better exploration of both anterior and posterior capsular labral complexes, and does not involve direct injury to the labrum or cartilage. However, it has similar drawbacks as allografting – a challenging learning curve, high cost, and additionally noticeable loss of ROM, especially in external rotation. Overall, this technique appears more appropriate to relieve patients' symptoms, such as painfulness leading to immoderate intake of painkillers, rather than achieving the ideally functional shoulder. In young patients with hEDS, this trade-off may be clinically acceptable [22].

Other authors, e.g., Armstrong et al. [26], have also described an all-arthroscopic technique. It consists of extra-articular anterior and posterior glenoid bone grafting. Regarding graft selection, the authors described the use of a distal tibial allograft or iliac crest graft. Since in this case we are considering more challenging patients because of their connective tissue disorder, the optimal approach to achieve stabilization of the shoulder should be carefully considered [26]. The addition of bony augmentation to the glenoid, which is not included in traditional stabilisation procedures, has been shown to improve stability by increasing the contact surface area [27]. Thus, shoulder stabilization may become more resistant

to postoperative changes inside the joint, such as progressive capsular stretching. The procedure has similar advantages and disadvantages as the aforementioned methods. Additionally, it is worth highlighting that both soft-tissue laxity (with capsular plication) and reinforcement of glenohumeral stability (with anterior and posterior glenoid bone graft) occur simultaneously [26].

Another modern arthroscopic approach for posterior shoulder instability in EDS patients is *latissimus dorsi* (LD) muscle transfer, since in this pathology the activity of the LD may be higher than physiological levels [28]. So far, this procedure has commonly been used to treat rotator cuff tears [29, 30]. This method enables redirection of force from the posterior to anterior side of the shoulder, and may help treat scapular dyskinesia, leading to potential rebalancing of the unstable shoulder. The LD tendon is transferred to the greater tuberosity, which may enhance the effectiveness of the procedure by converting the LD into an external rotator and providing additional dynamic stabilisation of the shoulder [28].

Open surgical management of patients with shoulder instability

Among non-arthroscopic procedures of hEDS patients which are still in use, we can distinguish open inferior capsular shift and shoulder arthroplasty, both being a viable option in surgical management of hEDS [15, 31].

The first method – open inferior shift – was analysed by Vavken et al. [31] in a study involving 18 shoulders in 15 hEDS patients. This technique was described in 1980 [32] and has been used since, with high success rates. The results showed that 87% of patients showed improved shoulder stability and decreased pain levels, with 64% having returned to physical activities. Among all the study participants, 47% had no episodes of instability, while another 47% reported periodic subluxation and just 1 patient (7%) experienced increased postoperative shoulder instability. The authors reported that after shoulder stabilization, the mean follow-up was 7.5 years. The findings suggest that inferior capsular shifts can produce predictable quality-of-life improvements in shoulder function in patients with hEDS. However, it is worth noting that, in addition to selecting the appropriate surgical approach for patients with hEDS, structured postoperative rehabilitation plays a crucial role in achieving optimal functional outcomes [31].

On the other end of the spectrum, Rogers et al. [15] in 2021 researched the outcomes of shoulder arthroplasty in patients suffering from hEDS. The study describes results and complications of 2 types of shoulder arthroplasties: anatomic total shoulder arthroplasties (6 patients) and reverse shoulder arthroplasties (4 patients). The follow-up averaged at 60 months, and the group's results

were compared to patients who underwent shoulder arthroplasty due to primary osteoarthritis or cuff tear arthropathy. The results showed that both cohorts experienced comparable pain relief, with no significant differences in changes in Visual Analogue Scale pain scores from preoperative to postoperative assessment [15]. Similar findings were observed in ROM in both forward elevation and external rotation. It is consistent with other reports [33, 34]. When comparing EDS and non-EDS cohort patients, there were no significant differences in complications and reoperations. Nevertheless, within the EDS patient group, complications and instability were present, highlighting the importance of careful patient selection and consideration of the most appropriate surgical approach by the treating physician [15].

In some cases of failed prior shoulder stabilization attempts, shoulder arthrodesis remains a potential salvage option for pain reduction and improvement of joint stability. This end-stage procedure has many indications and multidirectional shoulder instability *ergo* EDS is also amongst them [35]. The procedure described by Legato et al. [14] aimed to achieve arthrodesis (in 1 patient) with the shoulder positioned at 30° of flexion, 30° of abduction, and 30° of internal rotation. Postoperatively, functional mobility was assessed by evaluating elbow range of motion to ensure that the patient could comfortably reach the mouth. Additionally, follow-up ROM increased – the patient was able to reach the top of her head and lumbar spine through scapulothoracic motion. These findings are encouraging, particularly given that the patient had refractory shoulder instability and had failed previous surgical management [14].

Discussion

Diagnostic and clinical context of Ehlers-Danlos syndromes

Patients with EDS present a diagnostic challenge due to the heterogeneity of symptoms, which often include non-musculoskeletal manifestations, and the limited availability of definitive genetic testing, particularly for hEDS, for which no validated molecular diagnostic test is currently available [3]. As awareness of the condition increases and diagnostic guidelines are updated, the number of diagnosed cases is expected to rise. Despite advances in recognition, current management strategies frequently fall short of accomplishing optimal functional outcomes, highlighting the need for improved treatment approaches.

Surgical techniques for shoulder instability

Historically, surgical intervention in EDS has been approached cautiously because of concerns about tis-

sue fragility and high recurrence rates [13]. Recent literature describes both open and arthroscopic procedures as potential options in carefully selected patients. Several open and arthroscopic surgical techniques have been described for shoulder instability in EDS, including inferior capsular shift, arthroplasty [15, 31] and arthroscopic reconstructions with allografts [17, 18, 26, 36] or tendon transfers [28]. However, the available evidence is limited to small case series and single-patient reports, which precludes robust comparison of outcomes between techniques.

Trends, technical challenges and generalizability

Trends in surgical management suggest a gradual increase in the use of arthroscopic approaches [16]; however, this may be influenced by patient selection and diagnostic status. Newly developed procedures often require advanced surgical expertise and have a steep learning curve, which may further limit their generalizability. Importantly, long-term outcomes for many of the latest arthroscopic techniques remain unknown, emphasising the need for prospective studies with standardised outcome measures.

Role of conservative management and rehabilitation

Conservative management should remain the first-line treatment for shoulder instability in patients with EDS, particularly those with hEDS or hypermobility spectrum disorders (HSD). A recent systematic review by Higo et al. [37] (2024), specifically addressing shoulder symptoms in hEDS or HSD (hEDS/HSD), identified only 4 eligible studies, underscoring the scarcity of condition-specific evidence and the limitations of much of the earlier, non-hEDS/HSD literature.

Importantly, emerging evidence suggests that exercise dose and intensity may influence outcomes in hypermobile shoulders. In a randomised controlled trial of 100 patients with hypermobility-related shoulder symptoms, Liaghat et al. [38] (2023) demonstrated that a 16-week high-load strengthening programme was associated with superior improvement in the Western Ontario Shoulder Instability Index (WOSI) compared with low-load exercise, with a clinically meaningful direction of effect. These findings support the inclusion of appropriately dosed, progressive strengthening in rehabilitation programmes for this population [38].

Complementing this, Spanhove et al. [39] (2023) reported a 24-week randomised trial in patients with hEDS/HSD and multidirectional shoulder instability comparing supervised and home-based rehabilitation programmes.

Both groups showed significant improvements over time in shoulder-specific and functional outcomes, including WOSI, Disabilities of the Arm, Shoulder and Hand, and Patient-Specific Functional Scale scores, with no significant between-group differences. This suggests that structured home-based programmes may represent a feasible and effective approach, particularly in settings where access to specialised physiotherapy is limited [39].

Adjunctive interventions aimed at enhancing proprioception and external support, such as kinesiology taping, may provide additional short-term benefits in pain reduction and range of motion when used alongside structured rehabilitation, although the evidence base remains limited [25]. A quasi-experimental study by Chaléat-Valayer et al. [40] (2020) evaluated a short-sleeve compressive vest in individuals with joint hypermobility and demonstrated increased shoulder external rotation power, alongside high levels of user satisfaction. In a randomised controlled trial, Benistan et al. [41] (2023) reported significant improvements in balance outcomes both immediately and after 4 weeks when compression garments were combined with physiotherapy, compared with physiotherapy alone. More recently, a retrospective cohort study published in 2025 examining compression garment use in patients with hEDS/HSD reported potential benefits in pain and quality-of-life measures [24]. Taken together, these findings suggest that compression garments and proprioceptive supports may be considered as adjunctive strategies within rehabilitation for selected patients, particularly where proprioceptive deficits or symptom instability persist, while acknowledging the need for higher-quality, condition-specific trials.

Successful surgical outcomes are closely linked to postoperative rehabilitation, highlighting the importance of integrated, multidisciplinary care. Overall, rehabilitation should focus on neuromuscular control, proprioceptive training, and progressive strengthening of dynamic stabilisers, while avoiding excessive stretching.

Future directions

Given the limited evidence and heterogeneity of available studies, future research should focus on larger, prospective, multicentre cohorts with standardised outcome reporting. Studies integrating surgical intervention with rehabilitation protocols will be crucial for optimising patient outcomes and establishing evidence-based management strategies for this complex patient population.

Study limitations

This narrative review highlights several limitations, most notably the low level of evidence, as the available

literature is predominantly composed of single-patient case reports. In addition, multiple described surgical techniques are not supported by reported clinical outcomes, which limits meaningful assessment of their effectiveness and safety. These limitations substantially weaken the strength of the conclusions and should be considered when interpreting the findings, as the available evidence does not allow definitive clinical recommendations to be made. Therefore, further investigation in larger patient cohorts is required to better evaluate these approaches.

Conclusions

Surgical management options for shoulder instability in patients with EDS are evolving; however, the current evidence base remains limited and is largely derived from low-level studies. While both open and arthroscopic techniques have been reported as feasible in selected cases, definitive conclusions regarding their comparative effectiveness and long-term outcomes cannot be drawn. Surgical decision-making should therefore remain highly individualised and carefully balanced against the risks inherent to connective tissue disorders.

Conservative management should remain the cornerstone of treatment for shoulder instability in hEDS/HSD. Current evidence supports structured, progressive rehabilitation programmes emphasising strengthening of dynamic stabilisers, including higher-load exercise where tolerated, alongside neuromuscular and proprioceptive training. Emerging data also support the feasibility and effectiveness of progressive home-based rehabilitation programmes with appropriate monitoring, which may improve accessibility and long-term adherence. Selective adjunctive interventions, such as compression garments and proprioceptive supports, may provide additional benefit in selected patients, while techniques such as taping may offer short-term improvements in pain or range of motion.

Key gaps in the current literature include the absence of comparative studies of open versus arthroscopic surgical techniques, limited long-term outcome data, and inconsistent reporting of rehabilitation content and dosing. Future research should prioritise prospective, multicentre studies with clearly defined surgical indications, validated outcome measures, and long-term follow-up, alongside reliable evaluation of conservative rehabilitation strategies, to better inform evidence-based clinical decision-making.

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