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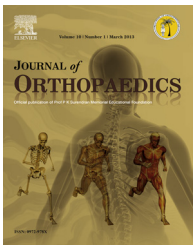

Review Article

Arthroscopic grading of common wrist disorders and its role in management

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ABSTRACT

Palmer devised a classification system to guide treatment of triangular fibrocartilage complex tears in 1989. The main division is between traumatic Type I and atraumatic Type II tears. The wrist arthroscopy makes diagnosis and treatment of ulnar impaction syndrome possible in a less invasive way. Arthroscopy is the most valuable tool for diagnosis and treatment of acute scapholunate and lunotriquetral dissociation. Arthroscopic grading of Kienböck's disease better describes articular damage compared with plain radiographs and can help surgical treatment. The wrist arthroscopy generally makes it possible to make the diagnosis of the chondral lesion before they are visible by the usual imaging.

1. Introduction

Wrist arthroscopy has steadily grown from a mostly diagnostic tool to a valuable adjunctive procedure in the treatment of myriad wrist disorders, and the number of conditions that are amenable to arthroscopic treatment continues to grow.[1]

Through wrist arthroscopy, triangular fibrocartilage complex (TFCC) injury diagnosis, classification, and treatment can be performed arthroscopically, including distal ulna resection (wafer procedure). Also, direct visualization of the articular damage compared with plain radiographs in Kienböck's disease can help guide surgical treatment options. Arthroscopic assessment of intercarpal ligament injuries and instability is now considered the gold standard by many authors. Arthroscopy can also aid us in the management of post-traumatic capsular contraction, resection of ganglia, and the relatively rare isolated ulna styloid impaction.[2]

Although wrist arthroscopy can identify an anatomic abnormality, it cannot be used to differentiate between asymptomatic degenerative conditions versus a pathologic lesion that is the cause of wrist pain. A thorough wrist examination is still integral to any arthroscopic assessment.[1]

2. Triangular fibrocartilage complex

One of the most common uses for wrist arthroscopy is the diagnosis and treatment of disorders of the TFCC. TFCC provides stability to the DRUJ and acts as a load-bearing

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Abbreviations: TFCC, triangular fibrocartilage complex; DRUJ, distal radio ulnar joint; 6R, 6 radial portal (radial to extensor carpi ulnaris); SLIL, scapholunate interosseous ligament; LTILl, unotriquetral interosseous ligament; DRCL, dorsal radiocarpal ligament tear.

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Table 1 – Classification and treatment of TFCC tears.[3]

Type of tear	Location of tear	Treatment recommendation
Traumatic		
1A	Tear in horizontal or central portion	Debridement
1B	Tear from distal ulna insertion ± ulnar styloid fracture	Repair
1C	Tear with ulnocarpal ligaments disrupted Tear of ulnolunate and ulnotriquetral ligaments	Controversial, open repair or reconstruction
1D	Tear from insertion at radius	Repair or debridement
Degenerative		
IIA	TFCC wear but no perforation	Scope to confirm that the TFCC is intact, then ulnar shortening
IIB	TFCC wear but no perforation; chondromalacia of lunate or ulnar head	Scope to confirm that the TFCC is intact, then ulnar shortening
IIC	Central perforation of TFCC Chondromalacia of lunate or ulnar head	Debridement of the TFCC and wafer procedure Alternative ulnar shortening
IID	Central perforation of TFCC; chondromalacia of lunate or ulnar head; perforation of LT ligament	Debridement of the TFCC and LTL, chondroplasty, possibly arthroscopic reduction and internal fixation of LT interval if unstable and/or ulnar shortening
IIE	Central perforation of TFCC; perforation of LT ligament; ulnocarpal arthritis	Debridement of joint or open salvage

structure.[3–5] As patients may have asymptomatic tears of the TFCC, the history and physical examination are of paramount importance.[3]

Palmer's classification of TFCC injuries can be used to help guide treatment (Table 1).[6] This divides lesions into Type 1 (traumatic) and Type 2 (degenerative).[2]

The classification of Type 1 TFCC injuries is based on the location of the tear (Fig. 1). Class 1A lesions involve the central or horizontal part of the TFCC. Class 1B lesions represent an avulsion of the peripheral aspect of the TFCC from its insertion onto the ulna (Fig. 1). Class 1C lesions occur when the ulnocarpal ligaments are disrupted. Class 1D lesions occur when the radial attachment of the TFCC is avulsed.[7,8]

Class 2 tears are staged according to the severity of degenerative changes involving the TFCC, ulnar head, ulnocarpal bones, and lunotriquetral ligament.[6]

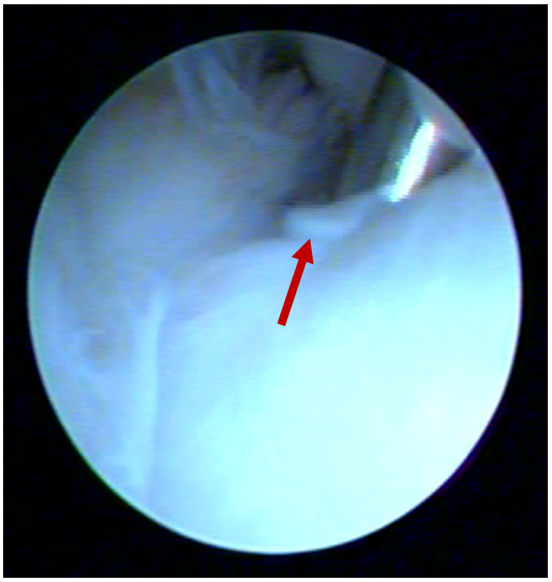

Fig. 1 – Type 1B TFCC tear.

All patients should have a trial of activity modification, splinting, and anti-inflammatory medication before embarking on surgical treatment. When non-operative treatment has been unsuccessful, wrist arthroscopy is indicated for the evaluation and treatment of TFCC injuries. On the basis of the location and size of the lesion, the surgeon may opt to either debride or repair the tear.[3]

Studies of the vascularity of the TFCC have shown that the central and radial aspects of the TFCC are relatively avascular.[9] Class 1A lesions are routinely debrided and have little effect on forearm axial-load transmission or DRUJ kinematics.[10,11]

Peripheral TFCC tears are often associated with DRUJ instability that requires repair (Fig. 2: arthroscopic outside in repair of Type 1A TFCC tear). Fortunately, it is the peripheral aspect of the TFCC that has sufficient blood supply to make repair feasible.[3]

Jantea et al.[5] and Trumble et al.[12] have suggested that class 1C and 1D tears of the TFCC may also be repaired.

Although the Palmer's classification system remains useful,[13] it does not clarify the most critical issue: the presence or absence of DRUJ instability.[14] In particular, the term ''class 1B injury'' is now being used to describe two distinct entities: a lesion that is fully stable at the DRUJ (i.e., central fibrocartilage disk separation from the dorsal wrist capsule) and a lesion that produces DRUJ instability (i.e., radioulnar ligament avulsion from the ulnar fovea). A great confusion has been generated in both the evaluation and management of class 1B injuries. The critical distinction is in differentiating injuries that produce instability of the distal radioulnar joint (DRUJ) from those that do not.[14]

Atzei and coworkers had developed a new classification attending to this important issue (Table 2). Based on the arthroscopic findings, five classes of TFCC peripheral tears are recognized, and guidelines for specific treatment can be considered.[15]

In degenerative lesions, the positive ulnar variance must be addressed in addition to debridement of the TFCC tear. Impaction syndrome may be treated surgically by an extra-articular ulna shortening or a wafer procedure.[3]

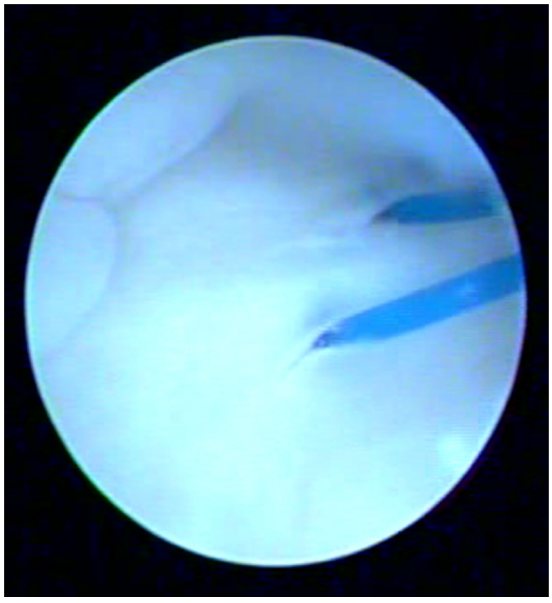

Fig. 2 – Arthroscopic repair of the Type 1B TFCC tear.

Fig. 3 – Arthroscopic wafer procedure.

Because of the efficacy of the open wafer distal ulna resection as a treatment for ulnar impaction syndrome, several authors have communicated good results with an arthroscopic wafer procedure for ulnocarpal abutment.[16]

Arthroscopic wafer resection is performed through the 3–4 and 6R portals (Fig. 3: arthroscopic wafer procedure). The central disk is excised using a basket forceps or a radio-frequency probe, it being mandatory that the dorsal and volar radioulnar ligaments are preserved. Once the ulnar head is visualized, a shaver is used to remove the remaining cartilage from the ulnar head. Afterwards, a 2.9 mm burr is advanced through the 6R portal and a 3 mm bony resection is affected.[14]

2.1. *Carpal instability*

Disruption of the scapholunate interosseous ligament (SLIL) or lunotriquetral interosseous ligament (LTIL) may occur in isolation or as part of a more extensive perilunate wrist dislocation.[17] Arthroscopy has become the gold standard for diagnosis of SLIL injuries, allowing direct vision of both intrinsic and extrinsic ligaments. The articular cartilage state can be checked under static condition as well as during the dynamic mode. We believe that all suspected injuries of the SLIL should undergo arthroscopy.[14]

Scapholunate instability without radiocarpal arthritis has been classified into pre-dynamic, dynamic, and static.[18] Nowadays, there is a wide variety of arthroscopic classifications of this instability. Geissler and co-workers have proposed one which is the most widely used arthroscopic classification.[19] Depending on the findings at the radiocarpal (Fig. 4) and midcarpal (Fig. 5) arthroscopy, it provides four degrees of injury (Table 3).[14]

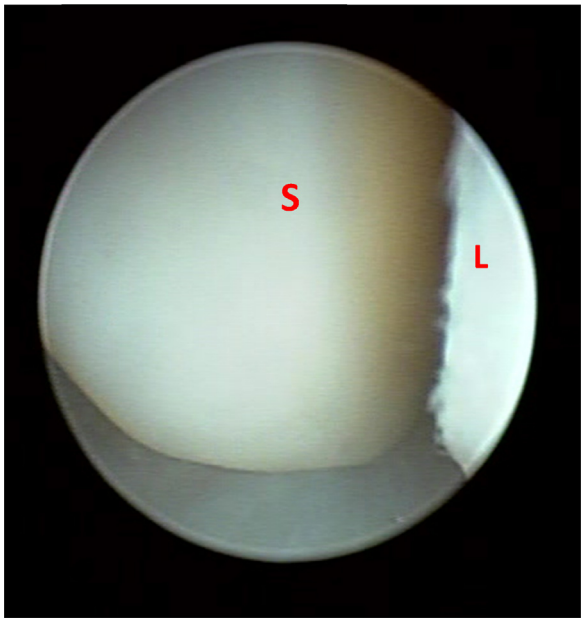

Fig. 4 – Radio carpal view of Gissler 4 SLL tear.

Table 2 – Atzei's TFCC complex peripheral tears classification.[15]

Class	DRUJ instability	Affected TFCC part	TFCC healing	DRUJ cartilage	Treatment
1	None/slight	Distal	Good	Good	Suture
2	Mild/severe	Distal + proximal	Good	Good	Foveal reattachment
3	Mild/severe	Proximal	Good	Good	Foveal reattachment
4	Severe	Proximal	Poor	Good	Reconstruction
5	Mild/severe	–	–	Poor	Salvage

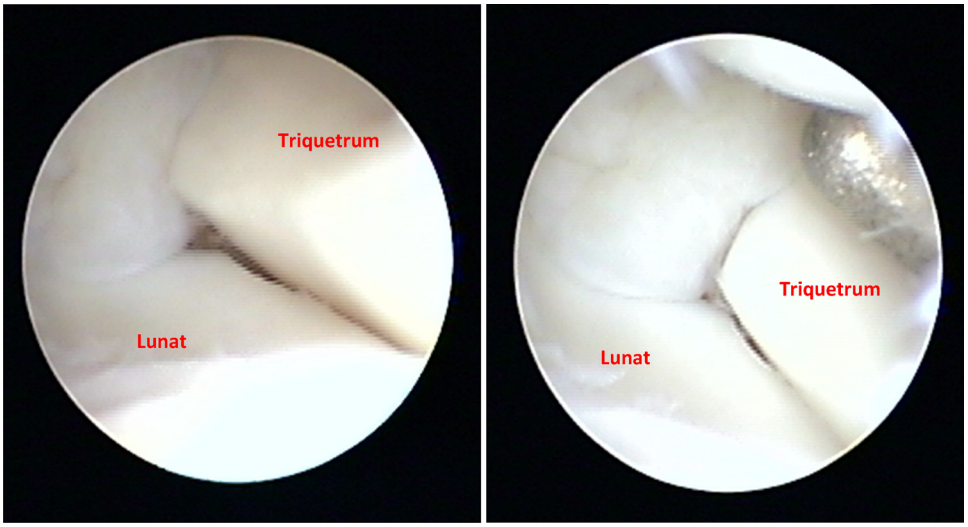

Fig. 5 – Midcarpal view of Gissler 2 LTL tear.

Table 3 – Geissler's interosseous ligament injury classification.[18]

Grade	Radiocarpal Joint	Midcarpal view	Carpal bone gap
1	Attenuation/Hemorrhage of interosseous ligament	No incongruence/step off	None
2	Attenuation/Hemorrhage of interosseous ligament	Incongruence/step off of the carpal alignment	Less than the width of the probe
3	Incongruence/step off of the carpal alignment	Incongruence/step off of the carpal alignment	Probe passes between the carpal bones
4	Incongruence/step off of the carpal alignment	Incongruence/step off of the carpal alignment	2.7 mm arthroscope passes between the carpal bone

Many of the SLIL injuries can be managed arthroscopically. Partial SLIL tears, without evidence of instability (pre-dynamic stage) can be addressed by means of debridement of the damaged tissue using a basket forceps or a radiofrequency probe.[14]

Grading the severity of injury is perhaps the most important step in the entire procedure of arthroscopic treatment of SLIL and LTIL. Grading the degree of LTIL disruption is done using a dynamic stress examination (Table 4). The scope and probe portals are reversed for grading the SLIL disruption.[17]

Mild forms of lunotriquetral instability can be treated with ulnocarpal ligament shrinkage. This procedure takes advantage of the anatomy of the ulnotriquetral and ulnolunate ligaments and these ligaments form a "V" as they diverge from their origin on the palmar distal radioulnar ligament and insert on the palmar aspect of the lunate or triquetrum.[1]

In cases where instability is seen (dynamic stage), debridement alone is not sufficient. There is a current controversy regarding the best treatment for these injuries. Some studies are reporting good results with arthroscopic debridement and

Table 4 – Arthroscopic classification and treatment of intrinsic ligament instability.[17]

Grade	Diastasis	Average of three midcarpal stress shift tests: distraction, translation, rotation	Treatment
I	Volar opening of 2.3 mm, no dorsal opening	Less than 10% shift	Partial tear does not require pin stabilization
II	2.3 mm or greater diastasis, both dorsally and volarly	Shifts between 10% and 25%: A: radiocarpal view, ligament reduced to normal bed B: radiocarpal view, ligament free edge not reduced	A: arthroscopic repair with early mobilization B: limited open direct anchor repair of ligament edge
III	2.5 mm or greater diastasis	Shifts > 25%: A: radiocarpal view, ligament reduced to normal bed B: radiocarpal view, ligament free edge not reduced	A: arthroscopic repair, no early mobilization owing to damaged secondary stabilizing ligaments B: limited open direct repair of ligament edge

Table 5 – Arthroscopic classification and treatment of DRCL tears.[1,29]

Stage	Description	Treatment
1	Isolated DRCL tear	Arthroscopic DRCL repair
2	DRCL with associated SLIL or LTIL (Geissler I/II) or TFCC tear or midcarpal instability	Arthroscopic DRCL repair, SLIL or LTIL debridement ± shrinkage, TFCC repair/debridement ± wafer
3A	DRCL tear with associated SLIL and/or LTIL (Geissler III) and/or TFCC tear	Arthroscopic DRCL repair, SLIL/LTIL shrinkage ± pinning, TFCC repair/debridement ± wafer
3B	DRCL tear with SLIL and/or LTIL (Geissler IV) and/or TFCC tear	Open SLIL repair/reconstruction ± capsulodesis, LTIL repair/reconstruction, TFC repair/debridement ± wafer
4	DRCL with chondromalacia or widespread degenerative changes	Partial carpal fusion versus PRC

Table 6 – Arthroscopic classification and treatment of Kienböck's disease.[26]

Grade	Articular surfaces involved	Treatment
0	Non	Extra-articular unloading
1	Proximal lunate surface	PRC, RSL arthrodesis or lunate excision and SC arthrodesis
2	The proximal + distal lunate surfaces	PRC, or SC arthrodesis
3	Proximal and distal lunate facet + the lunate facet of the radius	Total wrist arthrodesis or arthroplasty
4	All 4 articular facets are nonfunctional	Total wrist arthrodesis or arthroplasty

thermal shrinkage.[20,21] When faced with a reducible static scapholunate instability, Villanova and Del Pino[14] recommended an arthroscopic reduction of the scaphoid-lunate articulation, that has been described by Hausman et al.[22]

2.2. *Dorsal radiocarpal ligament tear (DRCL)*

In most series, the DRCL is overlooked during the standard arthroscopic examination because it is difficult to visualize through the standard dorsal portals. The DRCL is best viewed through the volar radial portal due to the straight line of sight. Isolated DRCL tears respond favorably to repair. Repairs may also be considered in cases in which the associated interosseous ligament tear or TFCC tear can be treated arthroscopically. A classification scheme for DRCL tears and its treatment is presented in Table 5.[1,23]

2.3. *Kienböck's disease*

Historically, the radiologic classification of Kienböck's disease of Lichtman et al.[24] has been used to assess the condition, although its reliability has been shown to be poor.[25] Arthroscopy provides direct visualization and assessment of the pathology in the radiocarpal and midcarpal joints. The disparity between radiographic assessment and arthroscopic assessment has been highlighted by Ribak,[26] who reported that plain radiographs were poorly correlated with arthroscopic findings.[2]

Wrist arthroscopy has become a valuable assessment and a primary treatment tool for Kienböck's disease. It allows identification of the nonfunctional joints and tailoring of the surgical reconstructions depending on the anatomic findings.[14]

Bain and Begg described an arthroscopic classification for Kienböck's disease based on the number of articular surfaces involved (Fig. 6).[27] In Grade 0, all articular surfaces are normal; hence, an extra-articular unloading procedure may be indicated. Grade 1 consists of 1 nonfunctional proximal lunate surface, which can be treated with a proximal row carpectomy, radioscapholunate arthrodesis, or lunate excision and scaphocapitate arthrodesis. In Grade 2, the proximal and distal lunate surfaces are nonfunctional, which requires a proximal row carpectomy or scaphocapitate arthrodesis. Grade 3 consists of nonfunctional articular surfaces of the proximal and distal lunate facet and the lunate facet of the radius. In Grade 4, all 4 articular facets are nonfunctional; hence, both require total wrist arthrodesis or arthroplasty (Table 6).[28]

2.4. *Chondroplasty and loose bodies*

Articular cartilage damage is a common cause of wrist pain; it may result from osteochondral fractures, chronic carpal instability, or chondromatosis, or it may occur idiopathically. Loose bodies are common sequelae of osteoarthritis. They may also be seen in avascular necrosis due to sloughing of a cartilage defect. Loose bodies give rise to pain and locking (Fig. 7: loose body in the radiocarpal joint), which is relieved following arthroscopic removal.[1]

Wrist arthroscopy is the best way to assess chondral defects. When non-operative therapy has failed to provide relief of symptoms caused by a cartilaginous lesion, arthroscopic management can relieve the discomfort, synovitis, and crepitation. Chondroplasty and removal of loose bodies may assist in

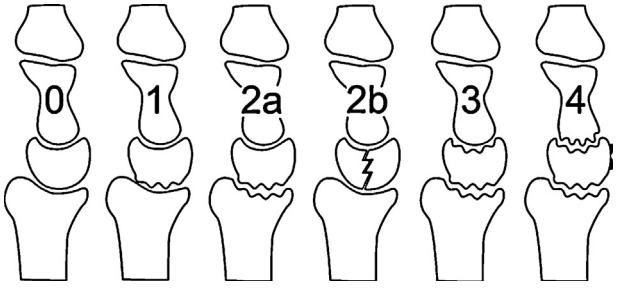

Fig. 6 – Arthroscopic classification of Kienböck's disease adopted from Bain GI, Begg M. Arthroscopic assessment and classification of Kienbock's disease. Tech Hand Up Extrem Surg 2006;10:8–13.

Fig. 7 – Loose body.

the reduction of wrist pain. As the wrist is a non-weight-bearing joint, the results are often better than those obtained with knee arthroscopy.[3]

Culp et al.[28] have provided a modified Outerbridge classification for chondral lesions in the wrist (Table 7) in which Grade I represents softening of the hyaline surface, Grade II consists of fibrillation and fissuring, Grade III represents a fibrillated lesion of varying depth in the articular surface, and Grade IV has a full-thickness defect down to bone. Grades I–III lesions are treated with debridement and localized synovectomy. Localized Grade IV lesions can be treated with abrasion chondroplasty and subchondral drilling.[1]

2.5. *Wrist contracture*

Patients lacking a functional arc of wrist motion who have failed a trial of dynamic/static progressive splinting are candidates for arthroscopic release of wrist construction.[1]

Lee and Hausman et al.[29] devised a classification system based on pathologic anatomic location (Table 8). Type I represents intrinsic adhesions, which are subdivided into radiocarpal (A), midcarpal (B), DRUJ (C), and combined (D).

Table 7 – Modified Outerbridge classification and treatment of chondral lesions in the wrist.[1]

Grade	Cartilage lesion	Treatment
1	Softening	Debridement and localized synovectomy
2	Fibrillation and fissuring	Debridement and localized synovectomy
3	Fibrillated lesion of varying depth	Debridement and localized synovectomy
4	Full-thickness defect down to bone	Abrasion chondroplasty and subchondral drilling

Table 8 – Wrist arthrofibrosis classification and treatment.[1]

Type	Site of arthrofibrosis	Treatment
Type I	**Intrinsic (adhesions)**	
A	Radiocarpal joint	Arthroscopic release
B	Midcarpal joint	Arthroscopic release
C	Distal radioulnar joint	Open release
D	Combination of above	Open release
Type II	**Extrinsic (capsular fibrosis)**	
A	Dorsal	Arthroscopic/open release
B	Palmar	Arthroscopic/open release
C	Distal radioulnar joint	Arthroscopic/open release
D	Combination of above	Arthroscopic/open release

Type II represents extrinsic contracture, which can be dorsal (A), volar (B), DRUJ (C), and combined (D). The surgical approach should be wrist arthroscopy for Types IA (radiocarpal adhesions) and IB (midcarpal adhesions) where intra-articular adhesions are present. Types IC (DRUJ adhesions) and IIC (DRUJ capsular contracture) are best approached in an open manner where dorsal and palmar capsulectomies of the DRUJ are performed. For Types IIA, B, and D (dorsal, palmar, and combination extrinsic contracture, respectively), both open and arthroscopic methods are used.

3. Conclusion

Wrist arthroscopy has become an essential tool for the hand and upper extremity surgeon. It is useful in diagnosing and/or staging a wide range of conditions of the wrist, including TFCC tears, Kienböck's disease, ligament injury, and cartilage injury. It can be of great benefit in evaluating wrist pain of unclear cause when imaging studies fail to elucidate the disease.

Wrist arthroscopy has steadily grown from a mostly diagnostic tool to a valuable adjunctive procedure in the treatment of myriad wrist disorders. The number of conditions that are amenable to arthroscopic treatment continues to grow. A detailed knowledge of the topographical and intracarpal anatomy, however, is essential to minimize complications and maximize the benefits.

Authors' contributions

M.B. participated in the sequence alignment and drafted the manuscript, H.E. participated in its design and coordination and helped to draft the manuscript, H.G. conceived the study, A.E. and W.S. collected the data about the whole subject.

Conflicts of interest

All authors have none to declare.

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