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ORIGINAL ARTICLE

Modified Phemister procedure for the treatment of type III Rockwood acromioclavicular joint dislocation. Results after five-years follow-up

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KEYWORDS

Shoulder;
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Abstract

Objective: Rockwood type III acromioclavicular (AC) joint dislocation is a common shoulder injury. Its treatment is subject to continuing controversy. The aim of this study was to evaluate the outcomes of the surgical treatment for Rockwood type III AC joint dislocation.

Patients and methods: Descriptive retrospective study between 2000-2006, including 67 patients who underwent modified Phemister procedure for the treatment of a type III AC joint dislocation. Patients clinically evaluated according to the Constant score. Data collection also included radiological findings, the presence of degenerative radiological changes, post-operative complications and a questionnaire on satisfaction with treatment received. Mean age of patients 34.1 years. Mean follow-up 4.7 years.

Results: Twenty-one patients were finally included. Functional result good/excellent in 88.5% according to the modified Constant score. Post-operative radiological reduction achieved in all patients, <50% of all cases being partially lost during the follow-up. Asymptomatic radiological degenerative changes appeared in 61.5% of the patients. Superficial wound infection and metal work migration were the most common post-operative complications. Patients expressed high satisfaction with the treatment received. After surgery no patient had to change their jobs or favourite sports activities.

Conclusions: Modified Phemister procedure provides a good result in the surgical treatment of Rockwood type III AC joint dislocation. Functional results and patient satisfaction with the treatment performed are very high. The partial loss of the radiological reduction during the follow-up does not necessarily mean a worse functional result, and in any case the radiological assessment was worse than that resulting from the initial injury. The ability to carry out normal daily living activities and the functional assessment obtained the most satisfactory results.

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PALABRAS CLAVE

Hombro;
Luxación
acromioclavicular;
Phemister;
Tratamiento quirúrgico

Tratamiento quirúrgico de las luxaciones acromioclaviculares tipo III de Rockwood mediante técnica de Phemister modificada. Evaluación de resultados a los cinco años

Resumen

Objetivo: Evaluar el resultado del tratamiento quirúrgico de la luxación AC tipo III de Rockwood.

Pacientes y metodología: Estudio descriptivo retrospectivo en 26 pacientes varones, con una edad media de 34 años, intervenidos con técnica modificada de Phemister, entre los años 2000 y 2006, por presentar luxación aguda AC tipo III de Rockwood. Los pacientes fueron valorados según escala de Constant, parámetros radiográficos, presencia de cambios degenerativos, complicaciones e índice de valoración subjetiva del paciente. El seguimiento medio fue de 5 años.

Resultados: La escala de Constant fue excelente o buena en el 88,5% de los casos con una reducción de la luxación en todos ellos, perdiéndose la reducción parcialmente menos del 50% durante el seguimiento. Un 61,5% de las imágenes presentaron cambios degenerativos asintomáticos. Las complicaciones más frecuentes fueron las infecciones superficiales y la protrusión de las agujas. El grado de satisfacción fue muy alto y ningún paciente cambió su actividad profesional o deportiva.

Conclusión: La técnica de Phemister modificada proporciona un buen resultado en el tratamiento quirúrgico de las luxaciones AC tipo III y la pérdida parcial de la reducción radiológica a medio-largo plazo no implica peor valoración funcional.

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Introduction

Dislocation of the acromioclavicular (AC) joint is an injury that appears as a consequence of certain traumatic acts affecting the shoulder. It usually occurs through a direct lesional mechanism of a fall onto the shoulder with the arm flung out from the body and the most frequent cause at the present time is the practice of sports. Its frequency is greater among men during the second decade of life.¹⁻⁴ With more than 50 different bandaging techniques available and over 30 different surgical techniques, the treatment of a type III AC dislocation still represents a controversial topic.

The connection between the upper limbs and the trunk of the skeleton is made through the acromioclavicular (AC) and sternoclavicular joints. Urist⁵ describes how a complete AC dislocation may occur in the horizontal plane without the rupture of coracoclavicular ligaments (CCL), but the upper displacement of the distal end of the collarbone is much greater if the ligaments are broken. Rockwood et al.⁶ for their part conducted studies into the movements in young adults with healthy shoulders, concluding that the rotation movements of the collarbone combine with a simultaneous rotation movement of the shoulder blade.

The classification of AC dislocations most commonly used derives from that described by Tossy et al.⁷ which acknowledged 3 degrees of lesion, depending on the integrity of the ACL and CCL ligaments. Allman et al.⁸ followed similar guidelines, but type III dislocations, as well as the upper displacement of the collarbone, are described with regard to an additional increase in the coracoclavicular

space (CCS). Subsequent anatomical studies allowed complete AC dislocations to be broken down into more detailed groups depending on the degree of lesion to the soft tissue and the direction of displacement of the collarbone. The group of Rockwood et al.⁶ described the most widely accepted classification system as prognostic and established treatment indications. Types I and II are consequential with other systems, establishing conservative treatment for these lesions whereas type III is characterized by the tearing of the ACL and CCL ligaments, with an increase of 25% to 100% in the CCS, with respect to the healthy side, and vertical AC displacement, with involvement of the trapezius and deltoid muscles, recommending surgical reduction. In type IV (posterior dislocation of the collarbone), type V (dislocation with an increase in CCS from 100% to 300%) and type VI (lower dislocation of the collarbone), surgery is recommended.¹

Following a type III dislocation of the AC, the patient will present pain, swelling and deformity of the AC joint, characteristically in an attitude with the arm *pulled in* and close to the body. The shoulder will be depressed and the most lateral end of the collarbone will appear prominently, raised and unstable, and can be pushed down by manual pressure from above. In order to confirm the diagnosis, anteroposterior X-rays must be requested with an angle of 10°-15°, with arms hanging down, displaying both shoulders in the same plate.⁹ Lateral and Stryker X-rays may help to rule out other lesions. Stressed radiological projections, using a weight of between 5 and 8 kg, help distinguish between lesions with type II or type III dislocations.¹⁰ The goal of our study is to evaluate the result of surgical treatment of Rockwood's type III AC dislocation.

Patients and methodology

Descriptive, longitudinal and retrospective study carried out at the Orthopaedic Surgery and Traumatology Department of the Virgen de la Salud Hospital in Toledo, on patients undergoing surgery, between 2000 and 2006, due to presentation of an acute Rockwood type III AC dislocation. During this period, 67 operations were performed on 67 patients.

Patients presenting prior lesions in the affected shoulder or accompanying lesions that might affect their functionality were excluded, as were those subjected to a surgical technique different from that reviewed in this study and those that could no longer be located. In the end, 26 patients meeting the inclusion criteria were located and recruited. A protocolized questionnaire was used to collect

information on identity, gender, age, anthropometric features, profession, sports activities, mechanism and cause of the lesion, as well as information on the surgical operation and post-operative recovery. Clinical data were also collected on the examination of the AC joint operated on (pain on palpation, paresthesia, deformity, hypertrophic scarring, residual instability and a subjective sensation of loss of strength).

All patients were assessed according to the validated functional scale of Constant, with a maximum of 100 points. Using this scale, we assessed subjective parameters on pain and activities of daily life (ADL) and objective parameters such as the range of mobility (ROM) and strength. The force (kg) was measured using a dynamometer attached by one end at the level of the waist with the patient pulling from the other end with his or her arm raised laterally to 90°.



Figure 1 Measurements of radiological assessment. a) Width of the AC joint, b) distance of the vertical displacement of the collarbone, c) coracoclavicular space (CCS). Percentage of vertical displacement of the collarbone = $(b / \text{collarbone width}) \times 100$. Increase in the CCS = $[(\text{CCS on the affected side} - \text{CCS on the healthy side}) / \text{CCS on the healthy side}] \times 100$.

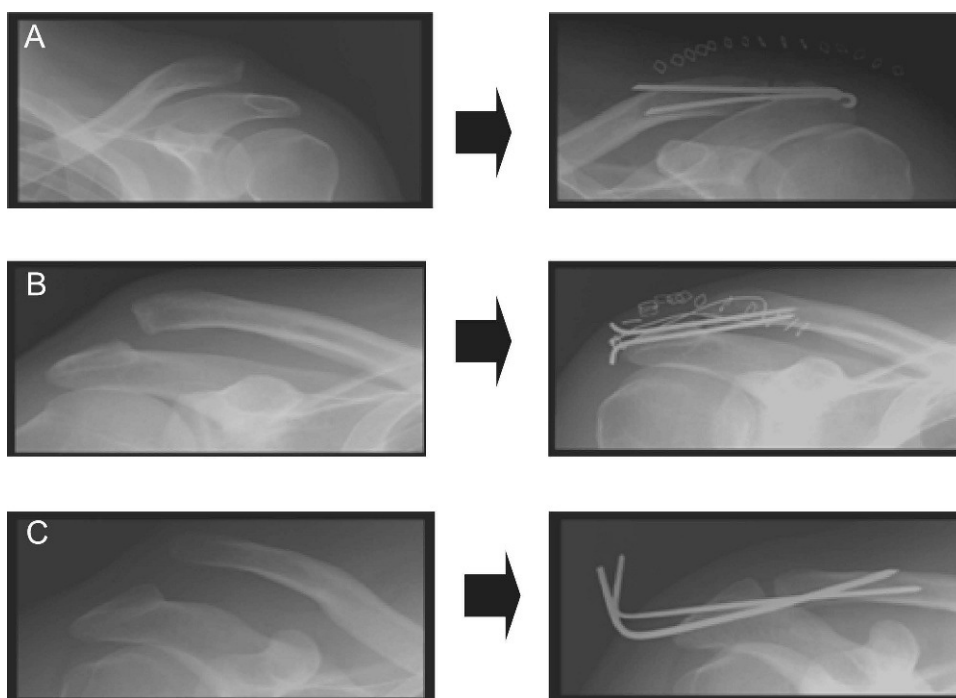


Figure 2 Surgical technique depending on the different modifications of the original Phemister technique. A) Open reduction and stabilization with 2 transarticular Kirschner needles, removal of the cartilage fibre from the joint and repair of the capsule, ACL and CCL ligaments. B) With a supported wire cerclage for supplementary stability. C) Closed reduction and stabilization of the AC joint with 2 Kirschner needles inserted percutaneously.

with the elbow in extension and the forearm prone.¹¹ The measure noted was the maximum obtained in 3 consecutive repetitions lasting for 5 seconds and with one minute's separation between them.¹²

In the X-rays from the pre-operative and immediate post-operative periods and the last check-up, the AC articular space, the distance of the vertical displacement of the collarbone, the coracoclavicular space (CCS), the percentage of vertical clavicular displacement and percentage increase in the CCS versus the control side were measured and recorded. Anteroposterior X-rays were taken of both shoulders at rest and with a hanging weight of 5 kg. The X-rays were effected in accordance with a protocol, including both shoulders in the same image, using the same computer application for the measurement. In addition, an assessment was made of the degenerative changes, calcifications, ligamentous ossification and bone resorption (fig. 1).

We also noted the patients' subjective satisfaction index (excellent, good, satisfactory and low) and whether they would undergo the same surgical treatment again.

With regard to the surgical technique performed (fig. 2), three different modifications on the original Phemister technique¹⁶ were used, depending on the surgeon's preferences. In 15 patients, an open reduction was carried out with stabilization using 2 Kirschner transarticular needles (fig. 2), with removal of the damaged cartilage fibre from the joint, followed by reduction and stabilization of the AC joint with 2 Kirschner needles inserted, under fluoroscopic control, from the lateral edge of the acromion, penetrating 2.5-4 cm into the collarbone and bending the needles on the lateral edge to prevent migration. Finally, the capsule and the ACL and CCL ligaments were repaired. Another 8 patients were operated on with the same technique described and with addition of a supported wire cerclage¹⁴ (fig. 2) and, lastly, 3 cases were operated on using a closed reduction and stabilization of the AC joint with two percutaneous Kirschner needles¹⁵ (fig. 2).

The mean age of the population admitted to the study was 34 years (range: 18-59 years). The lesion was in the right shoulder in 18 cases and the left shoulder in 8, affecting the dominant arm in 57.7% of cases. The mean follow-up at the time of the review was 57 months (range: 27-96 months). As for the causes of the lesion, this came about after a sporting accident in 50% of the cases, falls from a height in 19% and traffic accidents in 31%.

At the time of the review, 20 patients were found to be engaged in jobs with a high physical demands and 6 were sedentary or had not yet defined their profession. Sport was practised regularly by 73%. In all cases, following surgery, the limb operated on was immobilized using a sling for between 4 and 6 weeks, with the removal of the osteosynthesis material taking place after the third or fourth week. Of those patients seen to be less collaborative for physical exercise, 50% of the patients (n=13) were referred for rehabilitation following withdrawal of the osteosynthesis material to recover, over 5 weeks on average, their range of mobility. All patients except for 3 (who were not active at the time) remained off-work for an average of 10 weeks.

The outcomes were collected on an database in Excel and analyzed statistically using SPSS computer software for statistical analysis, with a difference between groups with p-values of less than 0.05 being established as significant.

Results

With respect to the post-operative complications, lateral migration of the needles was confirmed in 65.4% of the patients (n=17), on average after 3.3 weeks. Five patients developed a superficial infection of the wound. On the other hand there was a local deformity in 50% of cases (n=13) and a hypertrophic scar in 46.2% (n=12). Of the 8 patients in whom a wire cerclage was added, 6 presented local deformity or hypertrophic scar. We did not find any

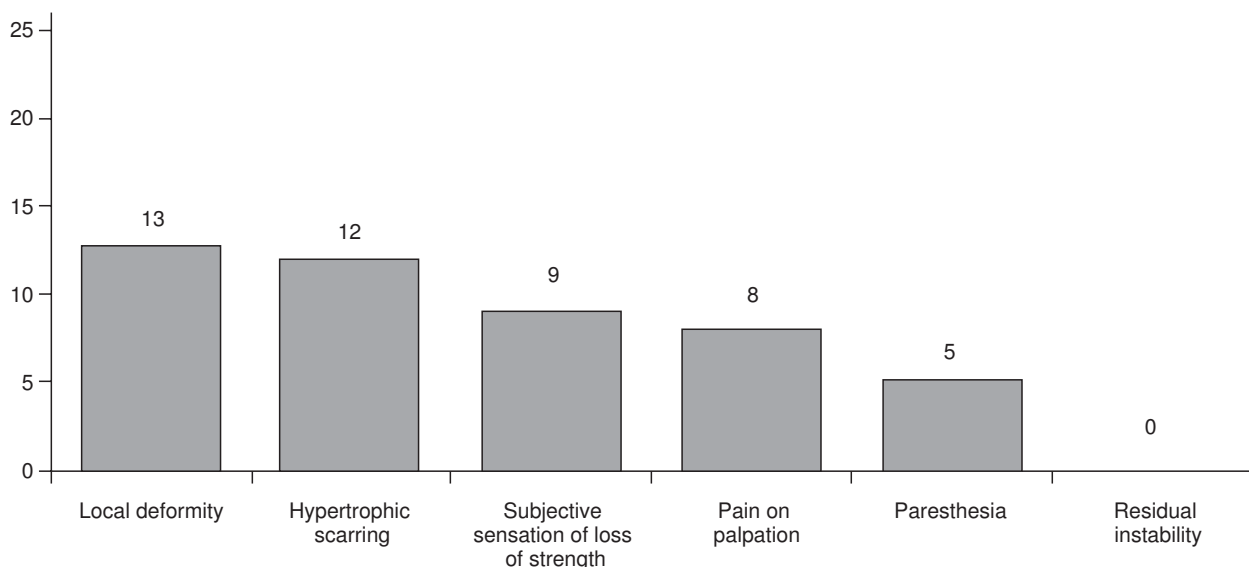


Figure 3 Clinical assessment after the follow-up period.

Table 1 Results, according to Constant's scale, on the shoulder operated and on the healthy shoulder

Patient	Shoulder operated					Control				
	Pain	Activities	ROM	Strength	Total	Pain	Activities	ROM	Strength	Total
1	10	19	40	20	89	15	20	40	20	95
2	15	20	40	16	91	15	20	40	16	91
3	12	20	40	16	88	15	20	40	14	89
4	10	19	40	20	89	15	20	40	20	95
5	10	19	40	18	87	15	20	40	18	93
6	13	20	40	24	97	15	20	40	22	97
7	8	19	40	22	89	15	20	40	22	97
8	10	20	38	16	84	15	20	40	16	91
9	15	20	40	12	87	15	20	40	12	87
10	8	20	40	16	84	15	20	40	14	89
11	13	20	40	18	91	15	20	38	20	93
12	12	20	40	18	90	15	20	40	16	91
13	15	20	40	14	89	15	20	40	10	85
14	13	20	40	21	94	15	20	40	21	96
15	8	20	40	18	86	15	20	40	18	93
16	3	18	38	11	70	15	20	40	12	87
17	11	20	38	12	81	15	20	40	12	87
18	8	20	38	18	84	15	20	40	19	93
19	10	20	38	17	85	15	20	40	18	92
20	15	20	40	20	95	15	20	40	20	95
21	15	20	38	10	83	15	20	38	10	83
22	15	20	40	16	91	15	20	38	16	89
23	13	20	40	18	91	13	20	40	16	89
24	15	20	40	24	99	15	20	40	18	93
25	15	20	40	22	97	15	20	40	18	93
26	15	20	40	22	97	15	20	40	22	97
Mean	11.8	19.8	39.5	17.6	89	15	20	39.8	16.9	92.5

ROM: range of mobility.

Table 2 Radiographic results in the coracoclavicular space (CCS)

	Pre-operative	Immediate post-operative	Last check-up
CCS	17.1	11.3	12.1
Increase in CCS(%)	64	8.9	17.3
Vertical displacement of the collarbone	8.9	1.7	3.3
Vertical displacement of the collarbone (%)	111.3	20.8	41.5
Acromioclavicular width	6	4.1	5.3

case of residual instability in the joint. Eight of the patients (30.8%) reported pain on local palpation and five (19.2%) presented paresthesia in the area of the surgical scar (fig. 3). No statistically significant relationship was found between the onset of these symptoms and the presence of deformity or hypertrophic scar.

With regard to the strength in the limb operated on, 34.6% of the patients (n=9) indicated a subjective reduction but this only coincided with an objective loss of strength in 3 cases according to Constant's scale; there was no relationship between the subjective and objective assessment of the strength in the limb operated.

According to Constant's scale (table 1), the median score in the shoulder operated on was 89 points, compared to 92.5 points on the control side, but this difference was minimal and was not significant. Ten patients presented a score equal to or greater than on the affected side (which corresponded to the dominant side in 6 cases). The activities of daily life and range of mobility even showed higher functional assessments on the affected side and no patient had to change their professional or recreational activity due to the lesion or its consequences.

In the 26 patients operated on, a post-operative reduction was achieved in the CCS (table 2), but this reduction was

not completely retained in 7 of the patients at the end of the follow-up (increase in CCS > 25%). However, despite the loss of reduction in these patients, a statistically significant relationship ($p < 0.05$) was found between obtaining a satisfactory post-operative reduction in CCS and the long-term maintenance of the reduction.

There is no statistically significant relationship between the partial loss of the reduction and the onset of any clinical sign or symptom. In other words, the partial loss of the reduction does not translate either clinically or functionally. With regard to the AC space, a post-operative reduction was seen in 25 patients, however there was a partial loss of the reduction after five years in 11 cases (42.3%). It is worth highlighting the outcome of the vertical displacement of the collarbone, with a very satisfactory post-operative reduction that only suffers a minimal loss during follow-up.

In the X-rays holding 5 kg of weight, a minimal increase in CCS and/or the distance of the vertical displacement of the collarbone, varying between 0 and 1 millimetres was observed, without any clinical or functional relevance. This result speaks in favour of the joint stability provided by the treatment using a Phemister technique, even in those cases with a partial loss of reduction during follow-up.

Asymptomatic degenerative changes were observed in 16 patients and this was the most frequent long-term alteration. Calcifications were also seen in 3 patients, bone resorption in 5 and a ligamentous calcification in 3 cases. We saw a relationship between the partial loss of reduction in the CCS and the onset of degenerative changes ($p=0.049$).

Within the levels of overall satisfaction, 23 patients reported a good or excellent result, 2 patients deemed it satisfactory and one patient considered the outcome unsatisfactory, with the good or excellent level of satisfaction accounting for 88.5% of the cases.

When asked if they would undergo the same surgical operation again, 96.2% of patients ($n=25$) answered in the affirmative; only one patient responded negatively.

Discussion

The function of the AC joint and its ligaments is to suspend the shoulder blade from the collarbone and support the weight of the upper limb. Lesions to this joint may lead to muscle fatigue, and downward displacement of the shoulder blade may give rise to compression of the tendon of the supraspinatus muscle by the acromion leading to neurological symptoms due to traction of the brachial plexus.^{17,18}

Phemister¹³ described his surgical method for the stabilization of AC dislocations using two transarticular Kirschner needles; this technique, with several modifications, is still used with favourable outcomes. Surgical repair is the preferred treatment and the Phemister technique is the most widespread^{13,15,18-20} although some authors defend the success of a conservative treatment of type III AC dislocations, as this presents results very similar to the surgical method.^{21,22}

Winkler et al.¹⁴ and Pfahler et al.²³ introduced wire cerclage, with 2 Kirschner needles to keep the AC joint reduced. Pfahler et al.²³ described a larger rate of long-

term degenerative changes when comparing this technique to others and a lower rate of pain improvement. However, we have not found significant differences in our series between the use or not of wire cerclage, and its relationship with the onset of degenerative changes or a lesser improvement in pain.

Corella et al.¹⁶ reviewed their outcomes with type III and type V AC dislocations treated using the Phemister technique, obtaining good results in the immediate post-operative period but with long-term relapses in 66% of the cases, aesthetic alterations in 66% and a satisfactory functional result in only 66% despite a high level of subjective satisfaction by patients. In this study, they mentioned the onset of radiographical alterations, such as ligamentous calcifications, but warned of the non-existence of patients presenting arthritic changes in their joints. We, on the other hand, have found asymptomatic degenerative changes in 60% of patients and a significant relationship between the partial loss of reduction in the CCS and the onset of radiographic degenerative changes, although without any possibility of relating their onset with any of the variations in the technique or with the presence of post-operative complications. Taft et al.²² defend a greater relationship between the onset of post-traumatic arthritis after AC fixation using transarticular techniques than with other techniques, but these are not accompanied by clinical manifestations.

One of the few prospective studies conducted²⁴ compares conservative treatment with treatment using AC fixation by Kirschner needles. The rehabilitation period was significantly shorter with conservative treatment but, after 13 months of follow-up, they did not find any differences in the clinical outcomes between the two groups. They recommend surgical treatment for acute grade III AC dislocations when there are aesthetic deformities due to a prominent lateral tip of the collarbone or in the case of workers requiring to exercise their shoulder at more than 90° of flexion and abduction when manipulating heavy loads.

Data have been published on better outcomes from early surgical treatment versus late treatment²⁵ although the definitive treatment of type III AC dislocations is still not without a certain degree of controversy. The most recent studies support the fact that younger patients, those of working age, and those with more severe degrees of displacement could benefit from surgical stabilization.²

Perhaps the greatest drawback to the Phemister technique is the migration of the osteosynthesis material.²⁶ In our series, almost to thirds of the patients suffered some degree of migration, which occurred on average after 3 weeks, generally when the patient was instructed to start with passive movements of the shoulder operated on. *Burying* the lateral tip of the Kirschner needles under the skin after having shaped them into a wide hook, or medially penetrating the cortex of the collarbone when inserting the needles despite the subcutaneous location of the collarbone, are some of the techniques most often used to prevent the lateral migration of the osteosynthesis material. The use of threaded needles has also been suggested to prevent this complication, but the authors have had no experience in the use of this stratagem. The surgical treatment of acute grade III AC dislocations with a modified Phemister technique

offers a good clinical, functional and radiological outcome in the medium to long term.

However, our study suffers from a series of limitations, such as the size of the sample obtained, its retrospective nature with a high loss of patients and the failure to conduct a comparative study with another treatment technique or method; our study only presents review data on the outcomes with a particular surgical treatment in the medium to long term.

Presentations

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Conflict of interests

The authors have not received any financial aid whatsoever for the execution of this paper. Nor have they signed any agreement whereby they will receive any benefits or fees from any commercial institution. On the other hand, no commercial institution has paid or will pay any foundation, educational institution or other not-for-profit organizations to which the authors are affiliated.

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