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RIVIEW ARTICLE

THE EFFECTIVENESS OF SELECTED PHYSIOTHERAPEUTIC METHODS IN THE TREATMENT OF PAIN IN THE COURSE OF LATERAL EPICONDYLITIS OF THE HUMERUS

SKUTECZNOŚĆ WYBRANYCH METOD FIZJOTERAPEUTYCZNYCH W LECZENIU BÓLU W PRZEBIEGU ZAPALENIA NADKŁYKCIA BOCZNEGO KOŚCI RAMIENNEJ

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ABSTRACT

Introduction

Lateral epicondylitis, otherwise known as the tennis elbow syndrome, occurs in 1–3% of the general population, of which tennis players account for only 10%. It is one of the most common causes of upper limb pain. Currently, due to the lack of uniform and consistent therapeutic methods, various treatment techniques are used. These include techniques such as shock wave therapy, ultrasound and cryotherapy.

Aim

The aim of the study is to assess the effectiveness of three physiotherapeutic methods – shock wave therapy, ultrasound and cryotherapy – in reducing pain in the course of treating tennis elbow syndrome. The secondary goal is to assess the grip strength of the hand.

Material and methods

As a result of the review of search engines and databases, such as Polish Medical Bibliography, Google Scholar, PubMed and ScienceDirect, 10 research works from 2010–2019 were used, assessing the effectiveness of shock wave therapy, ultrasound and cryotherapy to treat lateral epicondylitis of the humerus.

Results

310 people diagnosed with tennis elbow syndrome participated in the analysis. According to the results, most of the patients were female. The average age of the respondents was 45.2 years.

Conclusions

The research analysis proves that shock wave therapy, cryotherapy and ultrasound are effective physiotherapeutic methods in the treatment of lateral epicondylitis of the humerus. The shockwave is superior to other forms of treatment due to its shorter sessions and application time.

Keywords: tennis elbow, rehabilitation, cryotherapy

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STRESZCZENIE

Wstęp

Zapalenie nadkłykcia bocznego kości ramiennej, inaczej nazywane zespołem łokcia tenisisty, występuje u 1–3% populacji ogólnej, wśród których tenisiści stanowią jedynie 10%. Jest to jedna z najczęstszych przyczyn bólu kończyny górnej. Obecnie, ze względu na brak jednolitych i spójnych metod terapeutycznych stosuje się różnorodne techniki leczenia. Zaliczyć można do nich takie techniki jak: fala uderzeniowa, ultradźwięki oraz krioterapia.

Cel

Celem badania jest ocena skuteczności trzech metod fizjoterapeutycznych – fali uderzeniowej, ultradźwięków oraz krioterapii – w zmniejszeniu dolegliwości bólowych w przebiegu leczenia zespołu łokcia tenisisty. Celem pobocznym jest ocena siły chwytu ręki.

Materiał i metody

W wyniku przeglądu wyszukiwarek i baz danych, takich jak: Polska Bibliografia Lekarska, Google Scholar, PubMed oraz ScienceDirect do pracy użyto 10 prac badawczych z lat 2010–2019, oceniające za pomocą skali VAS (Visual Analogue Scale), skuteczność fali uderzeniowej, ultradźwięków oraz krioterapii w leczeniu zapalenia nadkłykcia bocznego kości ramiennej.

Wyniki

W analizie wzięło udział 310 osób ze zdiagnozowanym zespołem łokcia tenisisty. Zgodnie z wynikami, większość pacjentów była płci żeńskiej. Średnia wieku badanych wynosiła 45,2 lata.

Wnioski

Analiza badań dowodzi, iż fala uderzeniowa, krioterapia oraz ultradźwięki są skutecznymi metodami fizjoterapeutycznymi w leczeniu zapalenia nadkłykcia bocznego kości ramiennej. Fala uderzeniowa przewyższa pozostałe formy leczenia, ze względu na krótsze sesje i czas aplikacji.

Słowa kluczowe: łokieć tenisisty, rehabilitacja, krioterapia

Introduction

Lateral epicondylitis, also known as the tennis elbow syndrome, is one of the most common diseases of the elbow joint. It affects 1–3% of the general population aged 30–50. Although the name gives the impression that the tennis elbow syndrome arises in connection with playing sports, it often occurs in people working in an office or working physically. Tennis players account for only about 10% of them. Therefore, this type of inflammation can be treated as a significant public health problem. The main cause of lesions are additive minor injuries and overload of the extensor muscles of the wrist, leading to inflammation and then degenerative changes in collagen fibers. Patients most often experience pain on the side of the elbow that radiates along with the extensor muscles to the wrist. In addition, the grip strength is often weakened (Viswas *et al.*, 2012; Tosti *et al.*, 2013; Mastej *et al.*, 2018; Meunier 2020). Currently, there are several physiotherapeutic methods that are used to treat tennis elbow syndrome. These include shock wave therapy, which is characterized by a pressure surge, high amplitude and no periodicity. Ultrasound is also used, defined as mechanical vibrations of medium molecules exceeding 20.000 Hz. In addition, cryotherapy is used, which consists of short-term stimulus application of temperatures below 0°C.

The used physical treatments are aimed at reducing pain and inflammation within the elbow joint and maintaining the full physiological range of joint mobility (Yalvaç *et al.*, 2018; Holmedal *et al.*, 2019; Yan *et al.*, 2019; Guler *et al.*, 2020).

The most common assessment of the effects of analgesic therapy is the VAS (Visual Analogue Scale) scale. On its basis, the patient subjectively assesses the degree of pain from zero to ten, where zero means its absence and ten the maximum possible. While the tennis elbow syndrome occurs relatively often, no single structured and consistent workflow has yet been developed (Arrigoni *et al.*, 2017; Rosas *et al.*, 2017; Guler *et al.*, 2020).

Aim

The aim of the study is to assess the effectiveness of three physiotherapeutic methods – shock wave therapy, ultrasound and cryotherapy – in reducing pain in the course of treating tennis elbow syndrome. The secondary goal is to assess the grip strength of the hand.

Materials and methods

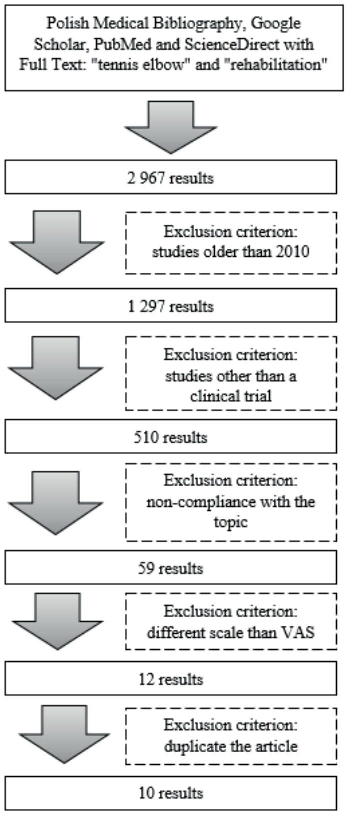
The work was reviewed in November 2020. Four search engines were used, such as Polish Medical Bibliography, Google Scholar, PubMed and ScienceDirect. The criterion used in the selection of the studies was the VAS scale, which enables the assessment of the effectiveness of analgesic treatment. Only clinical trials from 2010–2019, consistent with the topic of the work, were included. The abovementioned databases were searched using the combination of the keywords "tennis elbow" and "rehabilitation". After applying all the exclusion criteria, 10 works were qualified for the analysis (Figure 1).

Results

Ten original works were analyzed, six of which were Polish. Most of the research has been done in the last 5 years. Of the remaining ones, the oldest one was implemented in 2010. The aim of each of the studies was to demonstrate or compare the effectiveness of selected physiotherapeutic methods in the treatment of pain in the tennis elbow syndrome. Additionally, most of them assessed the grip strength before and after the therapy, which was also analyzed. The vast majority of works concerned the application of a shock wave, then ultrasound and cryotherapy. 310 people diagnosed with tennis elbow syndrome participated in the analysis. From the data presented in Table 1, it appears that the majority of patients were female. The average age of the respondents was 45.24 years. The methodology of the treatments in these groups of patients was not the same. After analyzing the data, it was found that the greatest differences concerned parameters such as the type of device, pressure, and frequency of impacts in shock wave treatments, head size and filling factor in ultrasound treatments, gas type and distance in cryotherapy treatments. Parameters such as the duration of therapy, number and frequency of treatments were similar. As a result of the research analysis, it was found that all the above studies prove a significant decrease in pain after the use of given therapeutic methods, of which seven were statistically significant. It turned out that the positive effect also applies to grip strength, where two out of six studies showed statistical significance. One study found that despite the reduction in pain sensation after shockwave therapy, the effect did not outweigh the placebo. The distribution of results between the shock wave and ultrasound shows that the ultrasound therapy is less effective, which does not change the fact that both methods can be considered effective.

Discussion

In this work, nine out of ten research papers demonstrate the effectiveness of selected physical methods in the rehabilitation of tennis elbow syndrome. These are the shock wave, ultrasound and cryotherapy. All methods of revalidation, despite the difference in methodology – the number of subjects,



age or treatment parameters – document the reduction of pain. In the groups where the grip strength was additionally assessed before and after the therapy, an improvement was also noted.

The beneficial analgesic effect of the shock wave is most likely due to the micro damages that arise as a result of the application of high force to the tissues. In this way, the body is stimulated to create regenerative mechanisms that improve the functional state of soft tissues. The shock wave effect also leads to the disintegration of calcium deposits in soft tissues, including in the course of tennis elbow syndrome, which is a frequent cause of pain (Yao *et al.,* 2020; Yoon *et al.,* 2020; Zheng *et al.,* 2020).

In the above review of works, it can be noted that most researchers performed the shock wave treatment according to similar guidelines. In terms of the frequency of procedures, only one author – Dobreci *et al.*, applied different principles. He subjected his research group to a five-week treatment with the treatment frequency twice a week, while the other authors were unanimous, and carried out the therapy for three weeks with the treatment frequency once a week. The effects were similar, both in the group with the three-week therapy and in the group with the five-week therapy; the pain symptoms decreased at a similar level (Dobreci *et al.,* 2014).

In addition to assessing the effectiveness of rehabilitation, four studies also considered the strength of the handgrip. They showed that the use of ESWT and RSWT increases its strength. The discrepancy in the results may only result from slight differences in the frequency, which ranged from 4 to 10 Hz, and the pressure within the range of 1.8–2.5 bar, as the rest of the parameters were identical.

Ultrasounds contribute to the stimulation of collagen fibers, which results in an increase in their elasticity. In addition, they improve blood circulation, and have a positive effect on tissue regeneration. They also stimulate the vegetative system, reducing

Table 1. Results.

Author, Year	Type of therapy	Characteristics of the group	Parameters	Results	
				Pain assessment (VAS)	**Grip strength**
Mróz *et al.*, 2014	ESWT	n = 15 no more data	d: BTL-5000 SWT POWER tt = 3 weeks ft = 1x/week nt = 3 ns = 2000 p = 2,5 bar f = 10 Hz	**Before therapy**	
				8.2 (SD +/- 1.6)	25 mmHg (SD: +/- 1.2)
				After 6 weeks	
				□ 4.4 (SD +/- 2.1)	□ 30 mmHg (SD +/- 0.5)
Dobreci *et al.*, 2013	ESWT	n = 43 W = 20 M = 23 a = 40–50	d: BTL-6000 SWT tt = 5 weeks ft = 2x/week nt = 10 ns = 2500–3000	**During resting before therapy**	
				5.3	
				During resting after therapy	
				□ 0.8	
				During resting after 3 months	
				□ 1.6	
				During activity before therapy	
				9.6	
				During activity after therapy	
				□ 1.6	
				During activity after 3 months	
				□ 2.3	
Capan *et al.*, 2015	RSWT	**Study group:** n = 23 W = 16 M = 7 **Control group:** n = 22 W = 19 M = 3	d:ShockMaster 500 tt = 3 weeks ft = 1x/week nt = 3 ns = 2000 p = 1.8 bar f = 10 Hz	**During resting before therapy**	
				Study group: 5.3 (SD +/- 2.7) Control group: 5.8 (SD +/- 2.6)	Study group: [kg] 11.96 (SD +/- 8.63) Control group: 8.50 (SD +/- 6.25)
				During resting after 1 month	
				Study group: □ 3.4 (SD +/- 2.9) (p < 0.001 vs before therapy) Control group: □ 3.5 (SD +/- 2.9) (p = 0.001 vs before therapy)	Study group: [kg] □ 15.96 (SD +/- 9.61) (p = 0.007 vs before therapy) Control group: □ 10.14 (SD +/- 6.42) (p = 0.002 vs before therapy)
				During resting after 3 months	
				Study group: □ 2.1 (SD +/- 2.2) (p < 0.001 vs before therapy) Control group: □ 2.6 (SD +/- 2.8) (p < 0.001 vs before therapy)	Study group: [kg] □ 17.30 (SD +/- 10.33) (p = 0.007 vs before therapy) Control group: □ 12.18 (SD +/- 6.01) (p = 0.002 vs before therapy)
				During activity before therapy	
				Study group: 7.9 (SD +/- 1.4) Control group: 8.0 (SD +/- 1.8)	
				During activity after 1 month	
				Study group: □ 5.6 (SD+/- 2.4) (p < 0.001 vs before therapy) Control group: □ 6.3 (SD +/- 2.6) (p = 0.004 vs before therapy)	
				During activity after 3 months	
				Study group: □ 3.3 (SD +/- 2.4) (p < 0.001 vs before therapy) Control group: □ 4.6 (SD +/- 3.1) (p < 0.001 vs before therapy)	
Franek *et al.*, 2012	ESWT	n = 10 W = 6 M = 4 a.a = 45.3	d: Piezowave tt = 3 weeks ft = 1x/week nt = 3 ns = 2000 f = 4 Hz	**Before therapy**	
				5.9 (SD +/- 2.5)	291.93 (SD +/- 153.87) [N]
				After therapy	
				□ 2.7 (SD +/- 2.4) (p < 0.05 vs before therapy)	□ 347.30 (SD +/- 159.58) (p < 0.05 v before therapy) [N]

Table 1. (cont.) Results.

Author, Year	Type of therapy	Characteristics of the group	Parameters	Results: Pain assessment (VAS)	Results: Grip strength
Wong *et al.*, 2017	ESWT	n = 17 no more data	d: Piezowave tt = 3 weeks ft = 1x/week nt = 3 ns = 2000	**Before therapy**	
				5.47 (SD +/− 1.97)	89.50 (SD +/− 22.42) [N]
				After therapy	
				□ 3.65 (SD +/− 2.18) (p < 0.05 vs before therapy)	□ 96.57 (SD +/− 22.77) [N]
				After 2 weeks	
				□ 3.18 (SD +/−2.13) (p < 0.05 vs before therapy)	□ 98.39 (SD +/− 22.64) [N]
Białek *et al.*, 2018	RSWT	n = 13 W = 9 M = 4 a.a = 45.1	d: ShockMaster 500 tt = 3 weeks ft = 1x/week nt = 3 ns = 4000 (2.000 for the lateral epicondyle of the humerus and 2.000 for the extensor muscles of the wrist) f = 8 Hz p = 2 bar	**During resting before therapy**	
				2.1	
				During resting after 1 week	
				□ 1.8 (p > 0.05 vs before therapy)	
				During resting after 3 weeks	
				□ 1.6 (p > 0.05 vs before therapy)	
				During resting after 6 weeks	
				□ 0.5 (p < 0.01 vs before therapy)	
				During activity before therapy	
				6.4	
				During activity after 1 week	
				□ 5.6 (p > 0.05 vs before therapy)	
				During activity after 3 weeks	
				□ 4.5 (p < 0.001 vs before therapy)	
				During activity after 6 weeks	
				□ 3.2 (p < 0.001 vs before therapy)	
	US	n = 13 W = 7 M = 6 a = 27–55 a.a = 45.1	d: SONICATOR tt = 2 weeks ft = 5x/week nt = 10 hs = 5 cm² f = 1 MHz P = 0.5 W/cm² t.t = 10 min ff = 1 : 4	**During resting before therapy**	
				4.2	
				During resting after 1 week	
				□ 1.7 (p < 0.01 vs before therapy)	
				During resting after 3 weeks	
				□ 0.4 (p < 0.001 vs before therapy)	
				During resting after 6 weeks	
				□ 0.5 (p < 0.001 vs before therapy)	
				During activity before therapy	
				7.9	
				During activity after 1 week	
				□ 3.8 (p < 0.001 vs before therapy)	
				During activity after 3 weeks	
				□ 2.1 (p < 0.001 vs before therapy)	
				During activity after 6 weeks	
				□ 2.0 (p < 0.001 vs before therapy)	
				RSWT vs. US – pain at rest (p > 0.05) – pain during activity (p > 0.05)	
Kubot *et al.*, 2017	RSWT	n = 30 W = 22 M = 8 a.a = 47.6	d: ShockMaster 500 tt = 3 weeks ft = 1x/week nt = 3 Phase 1: ns = 2000 (the area of the lateral epicondyle of the humerus) f = 8 Hz p = 1.5–2.5 bar Phase 2: ns = 2000 (trigger points of the short wrist radial extensor muscle) f = 8 Hz p = 2.5–3.5 bar	**Before therapy**	
				6.7 (SD +/− 1.90)	
				After therapy	
				□ 2.7 (SD +/− 1.66) (p < 0.0005 vs before therapy)	
				After 8 weeks	
				□ 2.37 (SD +/−1.75) (p < 0.0005 vs before therapy)	

Author, Year	Type of therapy	Characteristics of the group	Parameters	Results	
				Pain assessment (VAS)	Grip strength
Kubot *et al.*, 2017	US	n = 30 W = 13 M = 17 a.a = 43.9	d: BTL Topline 1000 tt = 10 days ft = 1x/day nt = 10 Phase 1: t.t = 3 minutes hs = 5 cm² P = 0.5 W/cm² ff =1 : 2 f = 1 MHz Phase 2: t.t = 2 minutes hs = 5 cm² P = 0.5 W/cm² ff = 1 : 2 f = 1 MHz	**Before therapy**	
				6.83 (SD +/– 2.29)	
				After therapy	
				□ 4.37 (SD +/– 1.88) (p < 0.0005 vs before therapy)	
				After 8 weeks	
				□ 3.93 (SD +/– 2.03) (p < 0.0005 vs before therapy)	
				RSTW vs. US after therapy p = 0.001 after 8 weeks p = 0.002	
Yalvaç *et al.*, 2018	ESWT	n = 20 W = 16 M = 8 a.a = 46.04	d: Elmed Vibrolith Ortho ver 3.0 tt = 3 weeks ft= 1x/week nt = 3 f = 10–15 Hz ns = 2000 p = 1.5–2.5 bar	**During rest before therapy**	
				1.5	18.95 [kg]
				During rest after therapy	
				□ 0 (p < 0.0001 vs before therapy)	□ 21.65 (p = 0.015 vs before therapy)
				During rest after 1 month	
				□ 0 (p < 0.0001 vs before therapy)	□ 22 (p = 0.015 vs before therapy)
				During activity before therapy	
				7	
				During activity after therapy	
				□ 5.5 (p < 0.0001 vs before therapy)	
				During activity after 1 month	
				□ 3 (p < 0.0001 vs before therapy)	
	US	n = 24 W = 15 M = 5 a.a = 43.74	d: BTL-58205 tt = 2 weeks ft = 5x/week nt = 10 P = 1.5W/cm² f = 1MHz hs = 1cm² t.t = 5 minutes	**During rest before therapy**	
				3	18.45 [kg]
				During rest after therapy	
				□ 0 (p < 0.0001 vs before therapy)	□ 21 (p = 0.001 vs before therapy)
				During rest after 1 month	
				□ 0 (p < 0.0001 vs before therapy)	□ 22.5 (p = 0.001 vs before therapy)
				During activity before therapy	
				7	
				During activity after therapy	
				□ 4 (p < 0.0001 vs before therapy)	
				During activity after 1 month	
				□ 2 (p < 0.0001 vs before therapy)	
				ESWT vs. US (VAS) during resting (p = 0.392) during activity (p = 0.674) ESWT vs. US (strength) (p = 0.552)	
Kawa *et al.*, 2015	Cryotherapy	**Study group:** n = 17 W = 13 M = 4 a.a = 45.9 **Control group:** n = 17 W = 13 M = 4 a.a = 46.6	d: KRIOPOL R-26 (liquid nitrogen) tt = 2 weeks ft = 5x/week nt = 10 t.t = 1–3 minutes dis.= 3 cm	**Before therapy**	
				Study group: 5.35 Control group: 5.35	
				After therapy	
				Study group: □ 2.76 (p = 0.001 vs before therapy) Control group: □ 5.11 (p = 0.001vs before therapy)	
Łukowicz *et al.*, 2010	Cryotherapy	n = 16 W = 10 M = 6 a.a = 44.5	Dwutlenek węgla tt = 2 weeks ft = 5x/week nt = 10 t.t = < 3 minutes dis.= 15–20 cm	**Before therapy**	
				6.1 (SD +/– 1.9)	10 (SD +/– 4.8)
				After therapy	
				□ 1.8 (SD +/– 1.2) (p = 0.000438 vs before therapy)	□ 15.9 (SD +/– 4.4) (p = 0.000438 vs before therapy)

the degree of excitability of the sympathetic nervous system, which results in lowering the pain threshold. All studies examining the effectiveness of ultrasound in the treatment of tennis elbow syndrome differed in the filling factor and the duration of the procedure. The number of treatments and the frequency were the same (Watson 2008; Daia *et al.*, 2021; Özmen *et al.*, 2021).

Kubot *et al.* states that both RSWT and ultrasound are effective methods of rehabilitation of the tennis elbow syndrome. However, it also indicates reduced effectiveness of the use of ultrasound. An appropriate article that could answer the above problem may be a study carried out in 2007, where Goraj-Szczypiorowska *et al.* concluded that the effectiveness of ultrasound might depend on the appropriate selection of parameters for a given procedure (Goraj-Szczypiorkowska *et al.*, 2007; Kubot *et al.*, 2017).

Cryotherapy reduces the temperature of the skin and subcutaneous tissues, acting analgesically. In addition, cryotherapy treatments inhibit the inflammatory process by reducing the local metabolism of cells within which inflammation occurs (Algafly *et al.*, 2007; Piana *et al.*, 2018). The differences in the analyzed studies concerned the gas used for the treatment and the distance between the nozzles (Łukowicz *et al.*, 2010). The analysis of studies in which cryotherapy treatments were used show a significant reduction in pain. Kawa *et al.* noticed that no statistically significant results were revealed in the control group, despite their slight reduction. The slight decrease in pain value can be explained by a spontaneous process healing inflammatory changes (Kawa *et al.*, 2015).

In their 2003 review, Smidt *et al.* observed that there is still insufficient evidence for most physiotherapeutic interventions due to conflicting results and a small number of studies. This review, 16 years later, is able to confirm the effectiveness of the selected methods (Smidt *et al.*, 2003). However, there are some imperfections in their course that may have influenced their results. First of all, the small number of respondents in particular groups, together with its insufficient characteristics significantly, reduced the quality of the research. Moreover, the lack of a control group in most of the studies made them less reliable. As the effectiveness of therapy is measured only immediately after treatment, some studies do not know the long-term effects of the therapy. The factor evaluating the presented work is the VAS scale; however, there are many other methods of assessing the effectiveness of rehabilitation of the tennis elbow syndrome that are worth investigating in order to confirm the results of the selected methods in more detail.

It is worth noting that untreated tennis elbow syndrome may result in problems affecting the biomechanics of this joint. These include muscle contractures, and thus a reduction in the range of motion of the joint, muscle weakness, instability or damage to the surrounding nerves or vessels (De Smedt *et al.*, 2007; Świtoń *et al.*, 2017).

As a result of the research analysis, there was a significant shortage of studies evaluating other physiotherapeutic methods in the treatment of tennis elbow syndrome than shock wave. Future researchers should take this into account.

Conclusions

The analysis of the presented articles proves that shock wave therapy, cryotherapy and ultrasound are effective physiotherapeutic methods in the treatment of tennis elbow syndrome. In addition, the shockwave is superior to other forms of treatment due to shorter sessions and application time. This type of therapy should be an alternative method of treatment for patients who, due to the lack of time, are unable to undergo daily therapy, such as ultrasound and cryotherapy. As a result of the research review, it can be concluded that there are few studies comparing various physiotherapeutic methods in the treatment of tennis elbow syndrome. The list of selected methods shows that shockwave therapy is much more often described. The above studies show the short- and medium-term effects of treatment; however, further studies on the long-term effects of the presented treatments should be carried out.

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