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A clinical case series

Results of arthroplasty of the Carpometacarpal Joint of the Thumb: A case series

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Abstract

Arthrosis of the carpometacarpal joint of the thumb is extremely relevant, as it affects up to 15% of the adult population, critically limiting the grasping function of the hand and fine motor skills. In the conditions of the aging society and the growing load on the hands (gadgets, work), the disease leads to early disability, requiring the development of new methods of treatment in addition to standard surgery.

The article presents an original and simple method for treatment of arthrosis of the carpometacarpal joint of the thumb, stage III-IV disease.

Surgical treatment was performed in 9 patients on 13 hands. The age of patients ranged from 48 to 64 years (mean 58 years). The clinical picture in all patients was typical for rhizarthrosis. The X-ray picture corresponded to stage III-IV rhizarthrosis. All patients underwent hematoma and distraction arthroplasty, entire trapeziectomy, distraction and fixation of the first metacarpal bone in a position of slight "overcorrection" with K-wire or a compression-distraction rod external fixation device. The results of treatment were studied in 8 patients (11 hands) from 2 months to 8 years after surgery (on average 3 years). 7 patients (10 hands) had no pain both at rest and during daily work. Moderate pain was observed in one patient in the immediate postoperative period (2 months after surgery). The opposition of the thumb to the fifth finger was restored in 6 patients (9 hands), in two patients (2 hands) opposition was possible to the fourth finger. The ability to reach the projection of the fifth metacarpal head with active flexion of the thumb was restored in the same proportion. Active radial abduction-adduction of the thumb was completely restored in all 8 patients. 7 patients (10 hands) were "very satisfied" with the results of the operation, one (1 hand) was "not completely satisfied." Absolutely all patients who underwent surgery returned to performing their previous domestic and professional duties in full. Follow-up X-rays showed clear proximal displacement of the base of the first metacarpal bone and narrowing of the gap between the first metacarpal and scaphoid bones.

Conclusions. Trapeziectomy with fibrous tissue interposition is a simple and minimally traumatic method for treating stage III-IV rhizarthrosis. To create the necessary space between the first metacarpal and scaphoid and for postoperative fixation, it is advisable to use a compression-distraction rod external fixation device.

Keywords: thumb, arthrosis, carpometacarpal joint, trapeziectomy, hematoma and distraction arthroplasty.

1. Introduction

Arthrosis of the carpometacarpal joint of the thumb is observed in 66% of women over the age of 55, and 22% of the population over the age of 50 have clinical manifestations of osteoarthritis [1]. Women suffer from this pathology six times more often than men [2]. In the early stages of osteoarthritis, conservative treatment is used [3]. If there is no positive effect after conservative therapy, in cases of severe pain, impaired hand function, and at the patient's request, surgical treatment is possible. Depending on the stage of osteoarthritis, different types of surgery are used. In the early stages, I-II according to the Eaton RG and Glickel SZ classification [3,4], denervation and corrective osteotomy of the first metacarpal bone are performed; in cases of joint instability and dorsal subluxation of the first metacarpal ligamentoplasty is performed to strengthen the palmar oblique ligament of the carpometacarpal joint [4,5,6]. In stages III-IV of osteoarthritis are used joint arthrodesis, prosthetic arthroplasty, partial resection of the distal half of the trapezium with interposition of various materials, complete removal of the trapezium with simultaneous ligamentoplasty and interposition of tendon tissue or synthetic materials, suspensionplasty, etc. [7]. All of the above methods of treatment for stage III-IV osteoarthritis have no advantage over each other in terms of achieving a positive treatment outcome. It should be noted that various complications are more common with arthrodesis and prosthetic arthroplasty of the carpometacarpal joint [2,8]. Therefore, it is logical to perform an effective, technically simpler, less labor-intensive, traumatic, and costly operation. In 2003, Kuhns CA et al. published such an effective, simple, and original method of surgical treatment of arthrosis of the carpometacarpal joint of the thumb: hematoma and distraction arthroplasty (HDA) [9]. We found no mention of the use of this operation in the practical work of surgeons and traumatologists in the available domestic literature.

The aim of this study is to familiarize the readers of the journal with an original, simple, and effective method of treating stage III-IV arthrosis of the carpometacarpal joint of the thumb.

2. A clinical case series

Surgical treatment for arthrosis of the carpometacarpal joint of the thumb was performed in 9 patients on 13 hands at the Kharkov Regional Traumatology Hospital (Kharkov, Ukraine), Medical Center of Western Georgia (Kutaisi, Georgia) and at the Medical Center Medina (Batumi, Georgia). The patients' ages ranged from 48 to 64 years (average age 58 years). Among this group, 6 were female and 3 were male. Four left hands, one right hand, and both hands of the same patient carpometacarpal joint of the thumb in 4 cases were operated on. The clinical picture in all patients was typical for this pathology: pain at rest and when performing bilateral grips, especially the pinch and key grips, impaired function and range of active-passive movements in the carpometacarpal joint of the thumb, instability and crepitus when performing movements, visible joint deformation. The radiographic picture corresponded to stage III-IV rhizarthrosis. The duration of clinical manifestations of the disease averaged 5 years. Four patients received conservative therapy prior to surgery with a short-term positive effect.

All 9 patients underwent arthroplasty (HDA) on 13 hands, as proposed by Kuhns CA et al. [9]. All patients gave their written informed consent to the operation. The study was conducted in accordance with the fundamental ethical principles of the Declaration of Helsinki.

The surgical technique is as follows. The surgical procedure can be performed either under general anesthesia, low or high regional anesthesia, or WALANT anesthesia [10]. In the latter case, there is no need to use a tourniquet to drain blood from the surgical field. In the projection of the carpometacarpal joint of the thumb on the dorsal-radial surface, a C-shaped incision is made, exposing the carpometacarpal joint space. When making the skin incision, close attention should be paid to the branches of the radial nerve and radial artery, which are isolated and retracted to the sides with hooks to avoid damage when accessing the joint. The trapezium is sharply and bluntly freed from the surrounding soft tissues. Make sure that the exposed anatomical structure is indeed the trapezium and not the base of the first metacarpal bone or the distal pole of the scaphoid. To do this, it is advisable to perform fluoroscopy. Clinically, this can be verified by distracting the thumb and performing passive movements with it, observing the movement of the base of the metacarpal bone in the joint space. After ensuring that the trapezium is free of soft tissue, an elevator and rongeur are used to attempt to remove the entire trapezium, which in most cases is not possible. Then, using an osteotome, a longitudinal osteotomy of the trapezium is performed and it is removed in pieces. The surgeon checks with his/her fingers to ensure that the trapezium has been completely removed. Any small fragments found with the finger should be removed completely. Flexor carpi radialis tendon can be seen deep in the wound. When performing osteotomy, care

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must be taken not to accidentally damage this tendon. The thumb is placed in a palmar abduction position at an angle of approximately 30 degrees, in moderate opposition, and distraction is performed until a feeling of pronounced resistance is felt. In this position, Kirschner wire is inserted through the base of the first metacarpal into the second metacarpal for fixation. A control X-ray is performed. The base of the first metacarpal should be at the level of the base of the second metacarpal or slightly more distal, and there should be no dorsal subluxation of the first metacarpal. If the position of the first metacarpal is unsatisfactory, the pin is removed, correction is performed, the pin is reinserted, and a control X-ray is taken. Once an acceptable position of the first metacarpal bone is achieved, hemostasis is performed. The hematoma formed from the wound is not removed. Sutures are applied to the capsule and skin, aseptic dressings are applied, and the thumb is immobilized with a plaster cast or orthosis. The sutures are removed on the 12th day, and fixation with Kirschner wires and plaster cast-orthosis is continued for 5 weeks from the day of the operation. After immobilization is discontinued, the patient continues to fix the thumb with a soft elastic bandage for several weeks and begins to carefully actively and passively develop movements in warm baths. Unlike the authors of the technique, we fix the first metacarpal with two wires (6 hands) or an external fixation rod device [11] – 7 hands (Figures 1, 2). We believe that this fixation is sufficient to prevent proximal migration of the thumb, and therefore we do not use additional external immobilization.

Figure 1 - X-ray image of the right hand of a patient with stage IV rhizarthrosis

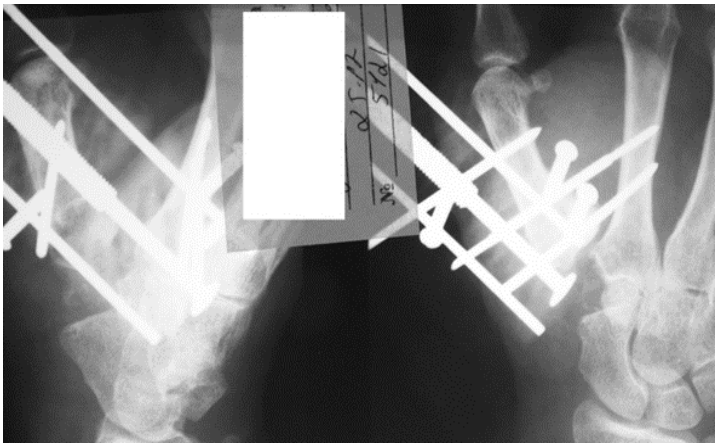

Figure 2 - X-ray image after hematoma-distraction arthroplasty in a patient with stage IV rhizarthrosis of the right hand

The results of treatment were studied in 8 patients (11 hands) between 2 months and 8 years after surgery (on average, 3 years later). In 7 patients (10 hands), there was no pain at rest or during daily activities in the long-term postoperative period. Moderate pain was observed in one patient in the immediate postoperative period (2 months after surgery). According to Kuhns CA et al., it is extremely difficult to determine the range of motion in the carpometacarpal joint using a goniometer and is impractical [9]. It is more understandable if the patient has regained full mobility of the thumb after surgery. Therefore, the authors believe that the result of the operation can be assessed as excellent if the patient is able to actively flex the thumb to reach the projection of the head of the fifth metacarpal, perform complete

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opposition of the thumb to the fifth finger, and easily perform radial abduction-adduction with the thumb. Opposition of the thumb to the fifth finger was restored in six patients (nine hands) (Figure 3), and in two patients (two hands), opposition was possible to the fourth finger.

Figure 3 - Opposition of the thumb of the patient's right hand four years after surgeryg

Figure 4 - Active flexion of the thumb of the right hand in the patient 4 years after surgery

In the same proportion, the ability to reach the projection of the head of the fifth metacarpal during active flexion of the thumb was restored (Figure 4).

Active radial abduction-adduction of the thumb was completely restored in all 8 patients (Figure 5).

We conducted a subjective assessment of the results of surgical treatment in the same way as the authors of the surgical technique. The patient was asked the question: "Are you satisfied with the results of the surgery on your thumb?" and then offered to choose one of the following answers: "very satisfied," "more satisfied," "not quite satisfied," "not satisfied at all." Seven patients (10 hands) were "very satisfied" with the results of the operation, and one (1 hand) was "not quite satisfied."

Figure 5 - Active radial abduction of the thumb of the right hand in a patient four years after surgery

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Absolutely all of the patients who underwent surgery returned to their previous daily and professional activities in full. It should be noted that after the operation, patients were able to perform both heavy physical labor and work involving fine motor skills of the thumb without pain. As in studies by other authors [9], control X-rays showed a clear proximal displacement of the base of the first metacarpal and narrowing of the gap between the first metacarpal and scaphoid (Figure 6).

Figure 6 - X-ray image performed 3 years after surgery on the left hand and 7 years after surgery on the right hand in a patient with stage IV rhizarthrosis

However, in no case were there signs of neoarthrosis formation between the scaphoid and first metacarpal bones. No complications were observed in the wound or at the exit sites of the wires or rods in any case. No differences in treatment outcomes were noted when using either wires or an external fixation rod device.

3. Discussion

Treatment of osteoarthritis of the carpometacarpal joint of the thumb is an actual problem, as pain and limited mobility of the thumb severely impair the function of the entire hand and lead to incapacity for work, both for people engaged in heavy physical labor and for professionals who have to perform delicate, precise manipulations.

In a significant number of cases, various conservative treatment methods with proven effectiveness can alleviate the condition.

If there is no positive effect after conservative therapy, in cases of stage III-IV osteoarthritis with a pronounced clinical picture, as well as at the patient's insistence, surgical treatment is performed.

For stage I-II rhizarthrosis, three methods of surgical treatment are usually used. Eaton RG et al. believe that pain in the carpometacarpal joint of the thumb occurs due to the destruction of the ligamentous apparatus of the joint and subsequent hypermobility with possible dorsal subluxation [4]. Therefore, to strengthen the ligamentous apparatus of the joint, restore its stability, which subsequently reduces pain, prevents the destruction of the articular cartilage and the progression of rhizarthrosis, the authors proposed their original surgical technique. Cut off half of the flexor carpi radialis tendon to the point of attachment to the base of the second metacarpal, then pass this tendon strip through the drilled hole in the base of the first metacarpal, then, below the attachment site of the abductor pollicis longus, return the tendon strip in the radial direction, throw it around the flexor carpi radialis tendon, and finally fix it to the joint capsule.

To change the biomechanics of the carpometacarpal joint of the thumb and thus redistribute the load on the joint surfaces, in 1973 Wilson JN performed corrective extension wedge osteotomy of the base of the first metacarpal in eight patients with rhizarthrosis [6]. The author believed that this would reduce joint pain and prevent further destruction of the articular cartilage.

Another fairly effective treatment for stage I-II rhizarthrosis is selective joint denervation [5].

For osteoarthritis of the carpometacarpal joint of the thumb in stages III-IV, a variety of surgical

procedures are used. In patients younger than 50 years of age and people engaged in physical labor, arthrodesis of the first carpometacarpal joint is possible. However, this significantly reduces the mobility of the thumb and causes osteoarthritis of adjacent joints, such as the scaphoid-trapezium-trapezoid joint, due to the redistribution of load during movement [12].

Prosthetic arthroplasty of the carpometacarpal joint using various designs, which is widely discussed in medical scientific literature, should also be approached with caution due to numerous complications: loosening, prosthesis migration, subluxations, cup splitting, and trapezium fractures [13].

In 1947, Gervis WH reported the complete removal of the trapezium in three hands in two patients [14]. The patients were satisfied with the results of the surgery. However, doctors still believed that after removal of the trapezium, proximal migration of the base of the first metacarpal and shortening of the first ray would inevitably occur, resulting in pain, muscle weakness, and a corresponding decrease in the strength of the thumb. Therefore, the researchers focused all their further efforts on developing treatment methods that prevent proximal migration of the first metacarpal. To preserve mobility in the carpometacarpal joint and the length of the first ray, the following were used: partial resection of the distal half of the trapezium with interposition between the base of the first metacarpal and the remaining part of the trapezium using various materials; complete removal of the trapezium bone with simultaneous ligamentoplasty and interposition of tendon tissue or synthetic materials; "suspension" of the first metacarpal using synthetic threads with locking elements ("buttons"), passing the thread obliquely through the base of the first and second metacarpal bones, and many other interesting methods and modifications [7].

Burton R et al. proposed the most popular surgical technique, which, according to the authors, prevents proximal migration of the first ray, ensures mobility and stability of the first metacarpal through a combination of complete trapeziectomy, interposition, and palmar oblique ligament plasty [15]. The principle of the method is that a trapeziectomy is performed, the flexor carpi radialis tendon is split into two strips, one strip is cut off in the proximal part and brought to the area of the distal attachment of the tendon to the base of the second metacarpal bone. The free strip of tendon is passed through the bone canal made in the base of the first metacarpal bone, returned to the entrance to the bone canal, where it is fixed in the form of a loop to the same tendon strip. The remaining free end of the tendon strip is formed into a "ball" or "snail" shape and placed between the base of the first metacarpal and the scaphoid bone.

A comparative scientific assessment of the results of surgical treatment did not reveal any significant advantages of any one method [2,8]. Therefore, it is advisable to use the simplest, least traumatic, and least expensive, but at the same time effective method of treatment. In our opinion, this method could be the operation proposed by Kuhns CA et al. [9]. A total trapeziectomy is performed, followed by distraction and fixation of the first metacarpal with a K-wire in a slightly "overcorrected" position. The gap formed between the base of the first metacarpal and the scaphoid in the postoperative period is filled with hematoma, which subsequently transforms into fibrous tissue. The resulting fibrous tissue provides the necessary range of motion, while also acting as a ligamentous apparatus and thus preventing posterior subluxation of the first metacarpal. Two years after surgery, 92% of patients were completely pain-free, and in the long-term postoperative period, compared to the preoperative period, the strength of the power grip increased by 47%, the strength of the lateral key pinch by 33%, and the strength of the tip pinch by 23% [9].

It is also noted that two years after surgery, the distance between the base of the first metacarpal and the scaphoid still decreases by 51%. However, this reduction in distance does not correlate at all with the clinical picture in terms of strength, mobility, stability, or pain, and therefore there is no need to measure this parameter or pay attention to it [2].

The results of our operations also confirm its simplicity and effectiveness. To create the necessary gap between the first metacarpal and scaphoid bones and for postoperative fixation, unlike the authors of the technique, we used an external fixation device. The use of the device allowed us to create the necessary gap between the first metacarpal and scaphoid accurately, in a controlled manner, and without much effort.

Although we did not encounter such a situation, we were still aware that after trapeziectomy, due to the proximal migration of the thumb, painful neoarthrosis between the first metacarpal and scaphoid may occur. A way out of this unfavorable situation may be to use an external fixation device to recreate the necessary diastasis between the first metacarpal and scaphoid and then perform any type of interposition or suspensionplasty.

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5. Conclusions

Trapeziectomy with fibrous tissue interposition is a simple and minimally traumatic method for treating stage III-IV rhizarthrosis. To create the necessary space between the first metacarpal and scaphoid and for postoperative fixation, it is advisable to use a compression-distraction rod device for external fixation.

The patient gave her written consent for the publication of the report and the posting of information on the Internet about the nature of her disease, the treatment performed, and its results for scientific and educational purposes.

Conflict of interest. The authors declare that there is no conflict of interest.

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Authors' contributions. Conceptualization – I.G.; methodology – S.G.; verification – M.R., M.G.; formal analysis – M.G.; writing (original draft preparation) – I.G.; writing (review and editing) – I.G., S.G.

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Қолдың бірінші саусағының артропластикасының нәтижелері: Клиникалық жағдайлар сериясын сипаттау

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Түйіндеме

Мақалада III-IV сатыдағы білек-алақан буыны 1 қол саусағының артрозын емдеудің бірегей әрі қарапайым тәсілін қолдану нәтижелері ұсынылған.

Хирургиялық ем 9 науқасқа (13 қол басына) жасалды. Науқастардың жасы 48-ден 64 жасқа дейін ауытқыды (орташа алғанда 58 жас). Барлық пациенттердің клиникалық көрінісі осы патологияға тән. Рентгенологиялық көрініс ризартрозның III-IV сатысына сәйкес келеді. Барлығына гематома-дистракциялық артропластика (hematoma and distraction arthroplasty) жүргізілді: толық трапециэктомия, 1 алақан сүйегін спицтермен немесе компрессиялық-дистракциялық өзекшемен шағын «гиперкоррекция» жағдайында дистракциялау және фиксациялау сыртқы бекіту аппаратымен.

Емдеу нәтижелері 8 науқасқа (11 қолдың басы) отадан кейін 2 айдан 8 жылға дейінгі мерзімде (орташа 3 жылдан кейін) зерттелді. 7 науқасқа (10 қолдың басы) тыныштықта да, күнделікті жұмысты орындау кезінде де ауырсыну болған жоқ. Бір науқасқа операциядан кейінгі кезеңде (отадан кейін 2 ай) орташа ауырсыну байқалды. Оппозиция 6 науқасқа (9 қолдың басы) бір саусақпен 5 саусақпен қалпына келтірілді, ал екі науқасқа (2 қолдың басы) оппозиция 4 саусақпен қалпына келтірілді. Осындай пропорцияда 5 алақан сүйегінің басы проекциясының 1 саусағын белсенді бүгу арқылы қол жеткізу мүмкіндігі қалпына келтірілді. 1 саусақты белсенді радиалды бөлу-келтіру барлық 8 пациентте толық қалпына келтірілді. 7 науқас (10 қолдың басы) жүргізілген операцияның нәтижелеріне «өте қанағаттанды», бір (1 қолдың басы) - «онша қанағаттанбады». Ота жасалғандардың барлығы өздерінің бұрынғы тұрмыстық және кәсіби міндеттерін толық көлемде орындауға оралды. Бақылау рентгенограммаларында 1 алақан сүйегінің негізінің анық проксимальды ығысуы және 1 алақан және алақан тәрізді сүйектер арасындағы саңылаудың тарылуы байқалды.

Қорытынды. Фиброздық тіннің интерпозициясы бар трапециэктомия III-IV сатыдағы ризартрозды емдеудің қарапайым әрі аз жарақатты тәсілі болып табылады. 1 алақан және алақан тәріздес сүйектер арасында қажетті аралықты құру және операциядан кейінгі бекіту үшін сыртқы бекітудің компрессиялық-дистракциялық өзекті аппаратын пайдаланған жөн.

Түйін сөздер: 1 саусақ, артроз, білек-алақан буыны, трапециэктомия, гематома-дистракциялық артропластика.

Результаты артропластики запястно-пястного сустава 1 пальца кисти: Описание серии случаев

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Резюме

Артроз запястно-пястного сустава (особенно первого пальца) крайне актуален, так как он поражает до 15% взрослого населения, критически ограничивая хватательную функцию кисти и мелкую моторику. В условиях старения общества и роста нагрузки на руки (гаджеты, работа) заболевание ведет к ранней инвалидизации, требуя разработки новых методов лечения помимо стандартной хирургии.

В статье представлен оригинальный и простой способ лечения артроза запястно-пястного сустава 1 пальца кисти III-IV стадии.

Хирургическое лечение было выполнено у 9 пациентов на 13 кистях. Возраст больных колебался от 48 до 64 лет (в среднем 58 лет). Клиническая картина у всех пациентов была типична для данной патологии. Рентгенологическая картина соответствовала III-IV стадии ризартроза. Всем проведена гематома-дистракционная артропластика (hematoma and distraction arthroplasty), тотальная трапециэктомия, дистракция и фиксация 1 пястной кости в положении небольшой «гиперкоррекции» спицами или компрессионно-дистракционным стержневым аппаратом наружной фиксации. Результаты лечения изучены у 8 больных (11 кистей) в сроки от 2 месяцев до 8 лет после операции (в среднем через 3 года). У 7 больных (10 кистей) отсутствовали боли как в покое, так и при выполнении повседневной работы. Умеренные боли наблюдались у одного больного в ближайшем послеоперационном периоде (2 месяца после операции). Оппозиция 1 пальца к 5 пальцу была восстановлена у 6 больных (9 кистей), у двух больных (2 кисти) оппозиция была возможна к 4 пальцу. В такой же пропорции была восстановлена возможность достичь при активном сгибании 1 пальца проекции головки 5 пястной кости. Активное радиальное отведение-приведение 1 пальца было полностью восстановлено у всех 8 пациентов. 7 больных (10 кистей) были «очень удовлетворены» результатами проведенной операции, один (1 кисть) – «не совсем удовлетворен». Абсолютно все прооперированные возвратились к выполнению своих прежних бытовых и профессиональных обязанностей в полном объеме. На контрольных рентгенограммах прослеживалось явное проксимальное смещение основания 1 пястной кости и сужение щели между 1 пястной и ладьевидной костями.

Выводы. Трапециэктомия с интерпозицией фиброзной ткани является простым и малотравматичным способом лечения ризартроза III-IV стадии. Для создания необходимого промежутка между 1 пястной и ладьевидной костями и послеоперационной фиксации целесообразно использовать компрессионно-дистракционный стержневой аппарат наружной фиксации.

Ключевые слова: 1 палец, артроз, запястно-пястный сустав, трапециэктомия, гематома-дистракционная артропластика.

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