

Лечение симптоматических несращений ключицы методом Илизарова

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Treatment of symptomatic clavicular non-unions using the Ilizarov technique

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Проперированы 14 пациентов с несращениями ключицы с использованием аппарата Илизарова в возрасте от 16 до 55 лет. Среди пациентов было 8 лиц женского (57,1%) и шесть мужского (42,8%) пола. Фиксация продолжалась в среднем 64 дня (от 31 до 95 дней). Средний срок наблюдения составил 34,7 месяца (от 24-х до 60 месяцев). У 11 пациентов (78,6%) получены отличные функциональные результаты. Эти пациенты могли вернуться к своей повседневной деятельности спустя 6 месяцев. У 2-х пациентов (14,2%) появлялась небольшая боль, связанная с переменной погоды, или когда пациент пытался отвести руку. У одного пациента (7,1%) была повторная операция после его попытки самостоятельно демонтировать аппарат.

Результаты настоящего исследования предполагают, что использование аппарата внешней фиксации эффективно для лечения несращений ключицы.

Ключевые слова: ключица, несращение, чрескостный остеосинтез, аппарат Илизарова.

The purpose of this study has been to present our experience and results managing the symptomatic non-union of the clavicular fracture. For this purpose we use the Ilizarov external fixator, applied in all fourteen patients in our study. Among numerous operative methods for solving the problem of clavicular non-union, which in most cases has appeared after the conservative treatment, we decided to use the Ilizarov external fixator. We have used it in all patients (fourteen) with the average of thirty years of age (range from sixteen to fifty-five years). There have been eight female (57,1 percent) and six male (42,8 percent) patients. The external fixator was retained sixty-four days in average (range from 31 to 95 days).

Preoperatively, in most patients there were symptoms such as pain in the affected shoulder with limited motion, a deformity on the site of non-union, swelling, and in one case the patient had a deep infection with fistulization, due to an open fracture. In one case the patient had already been operated. He had gone through the procedure that included osteosynthesis of the clavicle with the K-wires, which failed.

From 1994 to 1998 we operated all fourteen patients using the Ilizarov external fixator. The average follow-up was 34,7 months (range from 24 to 60 months). During that period the operated cases were examined both clinically and radiologically. In 11 patients (78,6 percent) the functional results were excellent. There was no pain on the site of consolidation, swelling, the deformity disappear while the motion in the shoulder was unlimited. These patients was capable to return to their everyday activities after six months. In two patients (14,2 percent) the mild pain appeared when the weather was changing or when the patient tried to abduct the arm. One patient (7,1 percent) was reoperated after trying to decompose the fixator by himself.

Postoperatively the results were satisfactory. Esthetic results were satisfactory for all patients (very small scars). Radiologically, in all patients the callus formation was achieved and pseudoarthrosis was sanated.

The results of the present study suggest that the external fixation using the Ilizarov device is an effective method for solving the symptomatic non-union of the clavicle.

Keywords: clavicle, non-union, transosseous osteosynthesis, the Ilizarov fixator.

INTRODUCTION

Fractures of the clavicle are among the most common skeletal injuries and are usually treated conservatively. There are rare situations in which they require open reduction and osteosynthesis, but one of the complications of open reduction and internal fixation is a high rate of non-union [6,7 percent] [12]. Several techniques of osteosynthesis in treatment of the clavicular non-union have been

proposed [13]. Each of these techniques has the risk of complications.

The purpose of this study is to present our experience and our results with Ilizarov external fixator which was the principle treatment that was used in fourteen patients who had non-union of the clavicle.

MATERIAL

During the period from 1994 to 1998, 14 consecutive patients with nonunion of the clavicle were treated using the Ilizarov external fixator. There have been nine female and five male patients. In all patients the fracture was the consequence of the trauma. The initial displacement of the fracture fragments were considered as minimal in four patients, moderate (1-2 cm) in five, and severe (more than two cm) in three patients. In two patients the fracture was comminuted.

All patients initially were treated with band in the shape of eight. The duration of immobilization after the injury ranged from six to eight weeks. The average age at the time of the operation was 30,1 years (range from 16 to 55 years). There were 12

atrophic and 2 hypertrophic non-unions.

The site of non-union in 13 patients was middle third of the clavicle, while in one patient the non-union occurred in the lateral third of the clavicle (Table I).

Preoperatively each patient complained of pain at the fracture site of motion with use of the ipsilateral shoulder. Four patients (cases No 1,5,7 and 10) had partially limited mobility of the shoulder, while ten patients had absolutely no limitation in motions. There were no signs of paresthesias in the distal part of the extremity with extreme abduction or flexion. The average duration of nonunion was 27,9 months.

Table I.

Case No	Age	Gender	Fracture site	Previous treatment	Type of pseudoarthrosis	Duration of unsolved fracture (months)	Associated complications	Follow-up (months)	Final result	Complications
1	20	female	mid 1/3	cons.+OP	hypertrophic	290	none	60	excellent	None
2	35	male	lateral	cons.	atrophic	10	none	36	excellent	None
3	17	male	mid 1/3	cons.	atrophic	6	none	24	good	None
4	16	female	mid 1/3	cons.	atrophic	4	none	24	excellent	None
5	55	female	mid 1/3	cons.	atrophic	8	none	36	excellent (after the reoperation)	Decomposition of the fixator by patient
6	48	female	mid 1/3	cons.	atrophic	5	none	48	excellent	none
7	35	male	mid 1/3	cons.	atrophic	24	infection	30	excellent	none
8	21	male	mid 1/3	cons.	atrophic	6	none	24	excellent	none
9	32	female	mid 1/3	cons.	atrophic	4	none	36	excellent	superficial infection
10	40	female	mid 1/3	cons.	atrophic	5	none	36	excellent	none
11	24	female	mid 1/3	cons.	atrophic	7	none	48	excellent	none
12	28	male	mid 1/3	cons.	atrophic	7	none	36	excellent	superficial infection
13	31	male	mid 1/3	cons.	hypertrophic	8	none	24	good	none
14	20	female	mid 1/3	cons.	Atrophic	7	none	24	excellent	none

TREATMENT

The patient is in the supine position with the pad under the shoulder of the affected site. The forearm and the hand are placed under the lumbar portion of the spine to allow the shoulder region to displace more anteriorly which permits the easier approach toward the clavicle. The head is placed in the opposite direction with lateral rotation. Two K-wires (2 mm in diameter) are placed primarily into the sternal fragment on the anterosuperior aspect, two centimeters from sternoclavicular joint, under the angle of 45 degrees toward the frontal plane. The wires are placed manually with the manual drill. Care must be taken to prevent over penetration of the wire into the internal cortex in

order to avoid damage of the structures under the clavicle. The second wire is inserted in the same manner and it must be parallel to the first K-wire in both AP and lateral planes. The distance between the K-wires is 1 cm. The two K-wires are inserted in the same manner into the acromial fragment. One K-wire is placed in superoposterior part of both fragments. The K-wires are bent upwards about 40 to 60 degrees, two centimeters over the skin. Then the wire clamp is inserted over the wires. The wire clamps are then connected with only one threaded rod if the fragments are in the anatomically satisfying position. In cases of severe dislocation of the fragments, the fixator can be modified by

adding more than one threaded rod to achieve anatomical position of the fragments. After the reduction of the fragments, the rod couplings are tightened with the wrench, thus locking the bar to the clamp. The final X-rays are taken to confirm a good reduction.

The free ends of the K-wire, over the wire clamps, are then cut (fig. 1). The distraction of the clavicle in length is achieved by moving the acromial part of the fixator laterally with the distraction speed of 1 mm per day by turning the screw on both sides clockwise and in the opposite directions until the distraction of the fragments of 4-5 mm has been reached. If it is necessary, the angulation and rotation correction of the fragments is done after which the external fixator is locked, regular shoulder motions are recommended from the first postoperative day.

Regular wire track cleaning should be

performed. Weekly postoperative X-ray controls are needed.

It is necessary to check the maintenance of reduction during the period of three weeks.

The fixator is removed after the non-union healing is confirmed.

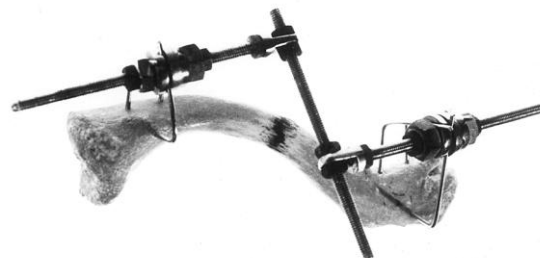


Figure 1- Ilizarov external fixator placed on the clavicle which consists of two wire clamps, three mutually connected rods and six K-wires.

RESULTS

The average length of follow-up in our study was 34,7 months (range from 24 to 60 months). During that period the operated cases were examined both clinically and radiologically. The average time of retention of the external fixator was sixty-four days (range from 31 to 95 days).

Complications

In one case (case No 5) there was failure of the procedure. The fixator went off a few days after the operation, because the patient himself took off one wire clamp so that he had to be reoperated. The bone-healing appeared and the final result was good. The deep infection was present in one case preoperatively (case No 7), as a consequence of an open fracture of the clavicle (Gustillo, grade 1) with fistulization. This patient preoperatively had been treated conservatively in the other institution. After the fistulectomy and administration of the antibiotic therapy, the infection ceased and the Ilizarov external fixator was applied with satisfactory final result. In two cases a mild superficial skin infection appeared around the K-wires, but this problem was

solved very soon by using the antiseptic solutions. Other postoperative complications, like neurological damage, thoracic outlet syndrome, deep infection, excessive scars or hyperaesthesia have not been observed.

Clinical and radiological results

In eleven patients the functional results have been excellent. There was no pain on the site of consolidation, and all of the patients were capable to continue their usual activities after six months. In two patients the mild pain sensations appeared when the weather was changing or when trying to abduct the arm. There was no case, postoperatively, in which the pain persisted on the operated side, no weakness in the shoulder region, and no limited motions. Esthetic results were satisfactory for all of the patients, because the scars were very small, while the deformity of the fractured clavicle became greatly reduced.

Roentgenographically, in all patients the sanation of the non-union was achieved with evident callus formation (fig. 2-A and 2-B).

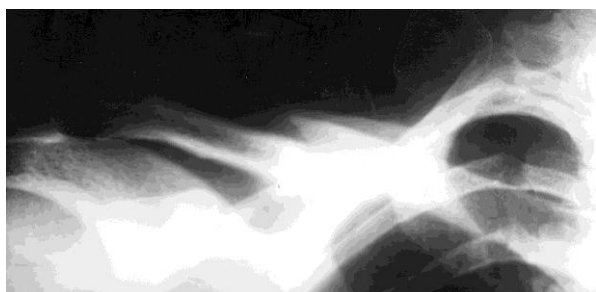


Figure 2-A - An anteroposterior radiography demonstrated an atrophic nonunion of the middle third of the clavicle.



Figure 2-B - External fixation with Ilizarov device by applying K-wires on the anterosuperior and posterosuperior aspect of the clavicle, ten weeks after the operation sustained consolidation with solid callus appeared

Figure 2- A and 2-B - Radiographs of thirty-two year old male (case No 13) who had a non-union of the clavicle, which appeared nine months after he had been involved in a traffic accident. After eight weeks of treatment, the formation of callus on the place of non-union of the clavicle was evident. .

DISCUSSION

The clavicle has an integral role in the function of the upper extremity and the non-union of the clavicular fracture may cause considerable functional deficiency [6]. A number of predisposing factors have been implicated in the etiology of non-unions. These include open fracture, refracture, associated severe trauma, operative treatment; insufficient length or stability of immobilization and the extended displacement of the fracture fragments [6]. The primary operative treatment of a clavicle fracture is a high-risk factor for nonunion [8]. In 13 cases of the present study, the cause of non-union mainly was the poor conservative treatment; and in one case (case No 1), the failure in the intramedullary fixation. In nine cases treated conservatively, the severe dislocation of the fragments was present. If the clavicular fracture has not been united during four months, with sclerotic and tapered fragment ends, and if bone apposition is unattainable, there probably exists a soft tissue interposition and spontaneous healing will not occur [8]. The non-union of an acute fracture of the clavicle has been reported in fewer than two percent of patients who were treated with standard close techniques. After surgical treatment the non-union is between 3,7 and 4,6 percent [10]. The non-union of the fracture usually occurs in displaced fracture of the middle third of the clavicle. The symptoms of pain, fatigability and weakness resulting from the non-union may be mechanical in origin, or they may be due to impairment of the fragments on the intimately juxtaposed neurovascular structures [2].

If the surgical treatment for the clavicular non-

union is planned, it is difficult to establish criteria. It is clear that success is not assured and the operation may be necessary [12].

Several operations have been described for the treatment of the clavicular non-union, including the partial claviclectomy, fixation with the wire sutures or interfragmentary screws; intramedullary pinning with Kirschner wires, Knowles pin, or Steinmann pin; compression plating and external fixation. A number of problems and disadvantages have been encountered with most of these techniques [2-10, 12].

In our study there have been no cases with presence of a brachial plexus compression syndrome as a consequence of hypertrophic clavicular non-union. Such cases are best treated with the resection of the non-united site. We have no reasons to open the place of non-union, and placing the Ilizarov external fixator have allowed us to achieve solid stabilization of the fragments and, finally, to reduce the deformity with solid bone consolidation.

The use of Ilizarov external fixator has permitted to restore the length of the clavicle, to control rotational forces of the fracture fragments, easy mobilization of the extremity, and provide a good stabilization and rapid healing of the clavicular non-union.

The results presented in our study suggest that the technique with Ilizarov external fixator is the treatment of choice for the patient with a symptomatic non-union of the clavicle. The technique is simple, safe, reliable and there is low risk of complications.

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