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POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 2/2021 (21) KWARTALNIK ISSN 1642-0136

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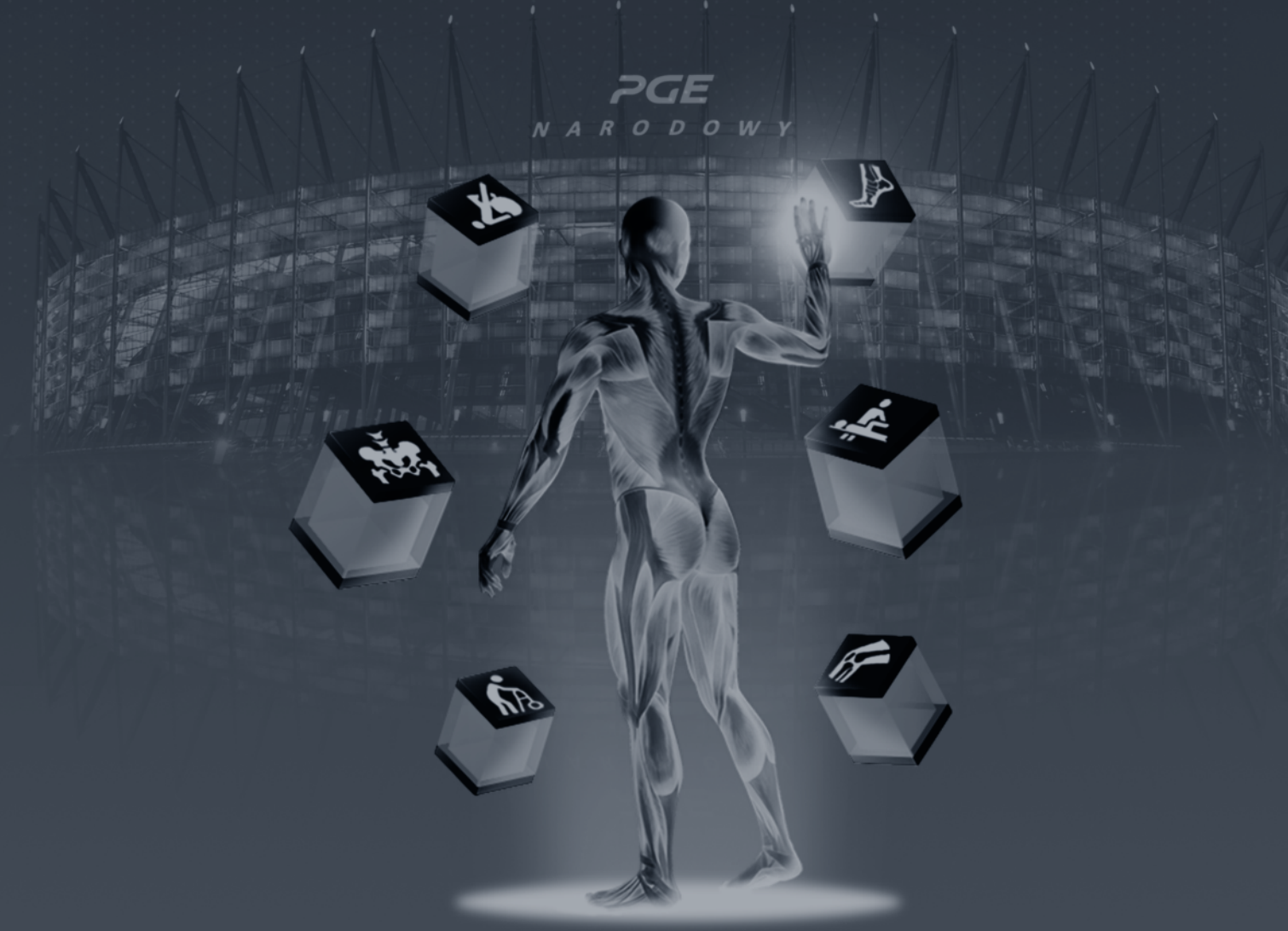

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nr 2/2021 (21)

Evaluation of the results of treatment of mandibular fractures on the basis of an original physiotherapeutic treatment program – preliminary reports

Ocena wyników leczenia złamań żuchwy na podstawie autorskiego programu postępowania fizjoterapeutycznego – doniesienia wstępne

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Abstract

Introduction. The 21st century is characterized by the dynamic development of the automotive industry and other industries. Along with them, the pace of our life increases, resulting in an increased trauma rate due to rush and traffic accidents. When looking for attractions, young people often get into conflicts or risk to impress their peers. As a result, traumatology grows into a vast branch of medicine, and mandibular fractures account for an increasing percentage of injuries.

Objective. The objective of the study was to assess the usefulness of physiotherapy in patients after orthopaedic and orthopaedic-surgical treatment of mandibular fractures for faster recovery of the masticatory organ function, and to introduce physiotherapy as a standard in treatment of patients after mandibular fractures.

Material and methods. The study involved a group of 20 patients aged 18–60 who suffered a mandibular fracture as a result of an injury. The patients were diagnosed and treated at the Clinical Department of Cranio-Maxillofacial Surgery and Oncology of Norbert Barlicki's University Clinical Hospital no. 1 in Lodz.

Results. The obtained results showed significant differences between patients who underwent physiotherapy after treatment of a mandibular fracture and those who did not want to participate in it.

Conclusions. This allowed for the conclusions to be made that the problems of patients after immobilization due to a mandibular fracture are significant and should constitute the starting point for the development of an appropriate physiotherapeutic treatment algorithm for these patients. It would also be advisable to promote physiotherapy as standard treatment in such cases.

Key words:
rehabilitation, physiotherapy, mandibular fracture

Streszczenie

Wprowadzenie. XXI wiek charakteryzuje się dynamicznym rozwojem motoryzacji i innych dziedzin przemysłu. Wraz z nimi wzrasta tempo naszego życia, co skutkuje zwiększoną urazowością ze względu na pośpiech i wypadki komunikacyjne. Młodzi ludzie, szukając atrakcji, często wdają się w konflikty albo ryzykują, aby zaimponować rówieśnikom. W wyniku tego traumatologia rozrasta się w obszerną gałąź medycyny, a złamania w obrębie żuchwy stanowią coraz większy procent urazów.

Cel. Celem pracy była ocena przydatności zastosowania fizjoterapii u pacjentów po leczeniu ortopedycznym i ortopedyczno-chirurgicznym złamań żuchwy w szybszym powrocie funkcji narządu żucia oraz wprowadzenie fizjoterapii jako standardu w leczeniu chorych po złamaniach żuchwy.

Materiał i metody. Badaniem objęto 20-osobową grupę pacjentów w przedziale wiekowym 18–60 lat, którzy w wyniku urazu doznali złamania w obrębie żuchwy. Chorzy byli diagnozowani i leczeni w Oddziale Klinicznym Chirurgii Czaszkowo-Szczękowo-Twarzowej i Onkologicznej Uniwersyteckiego Szpitala Klinicznego nr 1 im. Norberta Barlickiego w Łodzi.

Wyniki. Uzyskane wyniki wykazały znaczące różnice między pacjentami poddanymi fizjoterapii po leczeniu złamania żuchwy a tymi, którzy nie wyrazili chęci na uczestniczenie w niej.

Wnioski. Pozwoliło to na wyciągnięcie wniosków, iż problemy pacjentów po unieruchomieniu na skutek złamania żuchwy są znaczące i powinny stanowić punkt wyjścia dla opracowania odpowiedniego algorytmu postępowania fizjoterapeutycznego dla tych chorych. Wskazane byłoby także rozpropagowanie fizjoterapii jako standardu leczenia w takich przypadkach.

Słowa kluczowe:
rehabilitacja, fizjoterapia, złamanie żuchwy

Introduction

The 21st century is characterized by great technical development and the related fast pace of life. One of the key reasons for the increase in the number of various types of injuries is the constant development of the automotive industry (the multitude of cars on the roads determines the increasing number of accidents) and the lack of correct habits of people using cars (as many as 28% of Poles do not wear seat belts). The second infamous cause of facial skull injuries are beatings. Another is the tendency and fashion to engage in physical activity, including cycling, skiing and snowboarding, horse riding and martial arts.

In the face of the predominance of a sedentary lifestyle and lack of exercise, this is a positive phenomenon, however it results in the increased risk of injuries.

Gender and age of the patients are also important. Beating fractures in women and children are statistically insignificant. In over 80% of cases, they concern men aged 20–40, which is the period of the highest social and physical activity.

Age and gender do not matter in sports and motor vehicle accidents. A separate and small group (approx. 2%) are pathological fractures defined as spontaneous or resulting from a minor trauma.

As a result, traumatology – a field of science studying trauma and treating the consequences of trauma - has grown into a vast branch of medicine.

The subject of our interest in this study involves injuries of the facial part of the skull, which lead to fractures within the mandible, and the related rehabilitation issues.

A bone fracture (*fractura ossis*) is a break in the continuity of bone tissue resulting from a force that exceeds its mechanical strength. A traumatic fracture is the result of a strong stimulus applied to healthy bone. Mandibular fractures are the most common fractures of the facial bones of the skull - approx. 66%, even though the mandible is physiologically adapted to heavy loads. However, due to the lack of shielding by other bones and its anatomical position, it is the primary site of injury.

Most often, as much as in 30% of cases, fractures of the condylar process occur, in 25% they are fractures of the mandibular angle and body, in 15% of the chin area, in 3% of the branches and in 2% of the coronoid process.

Facial cranial injuries require special care and a good knowledge of diagnostics and treatment. Negligence and delays in treatment can have permanent consequences. Bone union in an incorrect position, facial scars or muscle contractions may cause breathing difficulties, impair the efficiency of the masticatory system or cause visual disturbances. Post-traumatic deformations within the facial part of the skull can lead to severe neurotic syndromes that have an impact on professional life, and can complicate personal life.

In patients with mandibular fractures, immobilization used in orthopaedic treatment is maintained for 6-8 weeks. After its removal, patients, due to prolonged inactivity of the muscles, have difficulty opening their jaws, which hinders their daily functioning.

Injuries to the facial part of the skull are dangerous not only due to damage to the soft tissues and bones. They often result in severe and multidirectional morphological and aesthetic

complications. They can disturb the physiological activity of systems such as the nervous system, visual system, respiratory system, digestive system and stomatognathic system. Improperly diagnosed and untreated or improperly treated and unrehabilitated injuries may often lead to permanent disability, which may for a long time or permanently exclude the patient from professional and private life [1].

According to WHO, rehabilitation is a medical and social process that aims to ensure people with disabilities a decent life with a sense of social benefit, and social and professional safety.

The purpose of rehabilitation is to shorten the recovery time, prevent complications and achieve healing in the right time. Physiotherapeutic treatment depends on several factors: first of all, fracture location, the type and treatment tactics adopted, the patient's age, general and social condition.

Physiotherapy and manual therapy play a very important role in the effective treatment of dysfunctions in the stomatognathic system, but have not yet found recognition among dentists. The reason for this may be, on one hand, the negligible amount of literature discussing the possibilities of using physiotherapy, and on the other hand, the lack of qualified physiotherapists in this field. The existing, single publications emphasize the role of early physiotherapy as a factor that significantly shortens the treatment time [2].

Manual therapy is one of the methods of treatment with movement (kinesiotherapy methods) resulting from the evolution of kinesiotherapy, in which repeated, effective, economic systems of treatment began to dominate. Its use is justified when there is a need to increase mobility in the area of contracture and to reduce pain. Good results in such ailments are achieved by post-isometric muscle relaxation (PIR).

PIR is the most important mobilization technique that uses the phenomena of muscle stimulation and inhibition. It is performed according to the following principles. Initially, tissue clearing should be selected and a barrier obtained. In the final position, the patient is instructed to perform active counter-resistance with the lowest possible force "as needed to push through a matchbox". This phase is called isometric and should last about 10 seconds (or until the muscle gets tired). Then the relaxation phase begins. The respiratory phases should be adapted to the appropriate stage of the procedure.

Treatment of the masticatory muscles using post-isometric relaxation techniques, except for the lateral pterygoid muscle, is performed similarly. The movement barrier is achieved by opening the mouth as wide as possible. The patient then tries to close them against minimal resistance. Mouth reopening causes muscles to relax. The mouth should be opened as wide as possible, and this movement should be combined with a deep breath, as in the case of yawning.

In the following study, we used the self-therapy technique, where the patient, sitting at the table, supports his/her elbow on the tabletop and stabilizes the forehead with the palm of the same hand. He/she puts the fingers of his/her other hand in his/her mouth, resting them on his/her lower teeth. He/she exhales and opens his/her mouth until the barrier is reached. And then, while inhaling, he/she enlarges the opening of the mouth as much as possible.

Active exercises
Active exercises are exercises that are performed with any muscle action without the help of external forces. The patient performs them independently under the supervision of a therapist. These are all movement exercises based on any activity of the muscle being rehabilitated. Due to the strength of the rehabilitated muscle, these exercises have been divided into active exercises, exercises without load, slow exercises and resistance exercises.

Resistance exercises
These are active exercises, hindered by additional resistance (springs, balls, dumbbells, therapist's hand).

Stretching
It is aimed at stretching the contracted muscles. By treating a mandibular fracture as a fracture of any other long bone, and treating the fracture with a plaster cast, and by comparing the effects of immobilization, exercises were selected to stretch the contracted muscles and strengthen the weakened ones. This allows the patient to function normally. There are some limitations to physiotherapy, such as fixed metal prosthetic restorations in the mouth, patients' fear of procedures involving the neck and head, and the general reluctance of patients to come to the facility every day to undergo a procedure due to a "trivial" problem. Due to the above arguments, in our study we place emphasis on exercises and PIR, which the patients - after prior extensive training - conducted at home and were accounted for at appropriate intervals.

Objective
The objective of the study was:
1. Developing own exercise model for patients after orthopaedic and orthopaedic-surgical treatment of mandibular fractures.
2. Demonstrating the usefulness of physiotherapy in treatment of patients with mandibular fractures.

Material and methods
The research material consisted of patients who suffered mandibular fractures as a result of an injury to the facial part of the skull. Due to the type of fracture and the position of the fracture fragments, they were qualified for orthopaedic treatment; one of the fractures was treated surgically with the use of plate osteosynthesis, and the other was treated orthopedically.
The study was carried out in the Department of Cranio-Maxillofacial Surgery and Oncology of Norbert Barlicki's University Teaching Hospital no. 1 in Lodz in 2014.
All patients who participated in the study gave their written consent. The study was approved by the bioethics committee.
The study included a group of 20 patients: 16 men and 4 women. The patients were divided into two groups: the control group and the study group in equal proportions.
The age of the patients ranged from 18 to 60 years.
The most common fracture in the patients in our study group was fracture of the condylar process, which was reported in 16 men (80%) and 4 women (20%), followed by fractures of the body, branch and angle.

After collecting the metrics and measuring the appropriate distances (the whole was included in the authors' questionnaire), physiotherapy was implemented in patients.
Exercises were performed from the first day after the immobilization was removed for a period of 4 weeks. The results were checked after the first, second and fourth week. Patients were compared with the control group in which there were patients who had received the same treatment but were not willing to exercise. Before starting to exercise, each patient learnt the exercises, received instructions and demonstration. The exercises were performed a certain number of times. In the first week stretching exercises were performed, and in the second week active resistance exercises were performed.

A set of exercises for patients with sample photos
The starting position for all exercises is sitting/standing in front of the mirror. Each exercise is performed 10 times, each time maintaining the final range of motion for 3 seconds.

Exercise 1
Inhale through the nose and exhale for a long time through the mouth maintaining the widest possible opening.

Figure 1. Opening the mouth as wide as possible

Exercise 2
Inhale with the nose and with prolonged exhalation with the mouth, pronounce letter "A" with the widest possible mouth opening.

Exercises 3 and 4
These exercises differ in the way the side movement is performed.
Movement:
• open the mouth as much as possible,
• move the mandible sideways to the right/left,
• return to the neutral position,
• close the mouth.

Figure 2. Left side movement of the mandible to the greatest possible extent

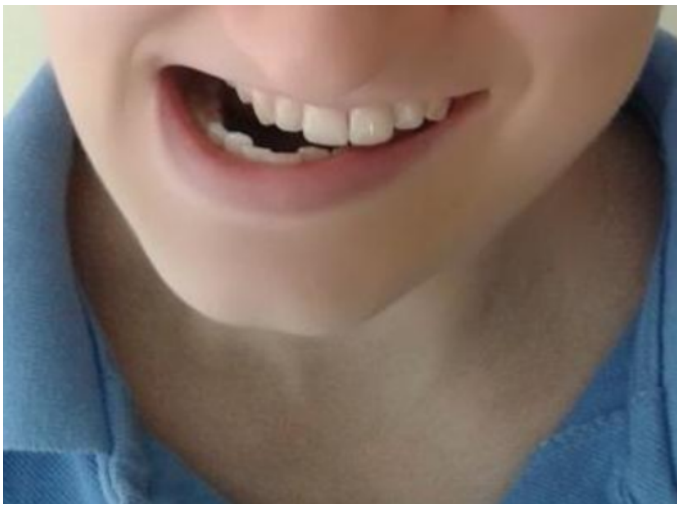

Figure 3. Right side movement of the mandible to the greatest possible extent

Exercise 5
This exercise is a combination of exercises 3 and 4.
Movement:
• open the mouth as much as possible,
• make a movement to the right and left, smoothly passing through the neutral position, without closing the mouth.

Exercise 6
Movement:
• open the mouth,
• make a move to place the upper incisors behind the lower incisors,
• return to the neutral position,
• close the mouth.

Figure 4. Maximum protraction

Exercise 7
Post-isometric muscle relaxation.
Starting position (SP) - sit at the table, elbow on its edge, hand resting on the forehead (stabilizing it), fingers of the other hand resting on the lower teeth, elbow hanging down.

Movement:
• open the mouth as much as possible, put a finger in the mouth, resting it on the lower teeth,
• by resisting with the fingers, close the mouth with as much force as is needed to push a matchbox through, maintain this movement for 5–8 seconds,
• exhale deeply,
• during a prolonged inhalation, open the mouth by pulling the mandible with the finger until you feel discomfort and resistance,
• repeat the exercise from the range obtained in step 4,
• lastly, perform the resistance exercise for opening the mouth without clamping the jaws.

Figure 5. The isometric tension phase in Post-isometric Muscle Relaxation

Figure 6. The relaxation phase in Post-isometric Muscle Relaxation

Exercises to strengthen the masticatory muscles
We commence performing these exercises only 14 days after commencing stretching exercises due to the sequence of exercises and the safety limit for obtaining proper and strong bone

union. All exercises are repeated 10 times in a sitting/standing position in front of the mirror.

Exercise 1
Maximum clenching of the teeth while maintaining tension for 5 seconds.

Exercises 2 and 3
Applying resistance with the hand to the left/right side of the mandible.
Movement: Perform the movement to the left against resistance.

Figure 7. Right lateral mandibular movement against resistance

Exercise 4
Putting the hand under the chin.
Movement: performing a downward movement against resistance.

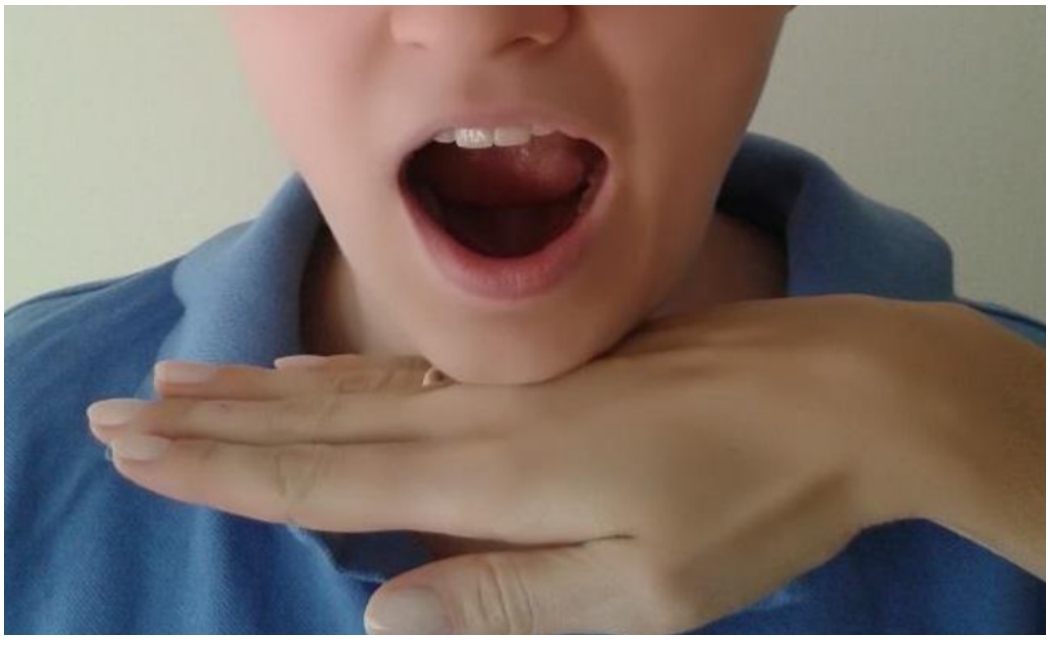

Figure 8. Opening the mouth against resistance

Results

Metrics

20 patients participated in the study – 16 men (80%) and 4 women (20%). The patients were divided into 2 groups of 10 people each: 8 men - 80% and 2 women – 20%.

A mandibular fracture was diagnosed in all patients who participated in the study. A double fracture also occurred. Table 1 presents a more detailed analysis of the types of fractures.

Table 1. Types of fractures in the control and study groups

Types of fractures							
Control group				Study group			
Condylar process	Branch	Angle	Body	Condylar process	Branch	Angle	Body
6	2	1	2	4	2	1	4

Analysing the above table, it can be observed that the most common fracture in the control group was fracture of the condylar process (6 people, i.e. 60%), the fracture of the body and the branch took the middle position (2 people, respectively, which gives 20%), and fractures of the mandibular angle were least common (1 person – 20%). On the other hand, in the study group, fractures of the condylar process and the body occurred most frequently ex aequo (4 persons each – 40%), and there were the same numbers of fractures of the branches and the angle as in the control group.

Table 2. Treatment applied in the control and study groups

Treatment			
Control group		Study group	
Orthopaedic	Surgical and orthopaedic	Orthopaedic	Surgical and orthopaedic
10	0	9	1

The table above shows the choice of treatment method, depending on the site of fracture, patient condition, age and consent, among other factors. In the control group, orthopaedic treatment was applied in 100%, and in the study group orthopaedic treatment was applied in 90% and surgical and orthopaedic treatment was applied in 10%.

Table 3. Type of equipment used in the control and study groups

Type of equipment used						
Control group			Study group			
Chin pad	Individual splints + elastic maxillo-mandibular fixation + pad	Ivy loop fixation + pad	Chin pad	Individual splints + elastic maxillo-mandibular fixation + pad	Ivy loop fixation + pad	Plate osteosynthesis
1	5	4	2	6	2	1

In the control group, the least frequently used treatment was a chin pad (1 person), used in a patient with a fracture without fragment displacement, who was very disciplined. The most common were individual splints with rubber fixation supported by a chin pad (5 people – 50%); Ivy loop fixation (4 people – 40%) was in the middle of the classification. On the other hand, in the study group, the use of individual splints was predominant, followed by the use of only the pad and Ivy loop fixation ex aequo. One person with a double fracture underwent plate osteosynthesis involving fracture of the body. It is worth mentioning that in the study group, two types of equipment were used in one person (plates + individual splints) due to two fractures within the mandible.

Evaluation of the possibility of oral cavity movements in the sagittal plane

Table 4. Evaluation of oral cavity movements in the sagittal plane in the control group

	Control group			
	1 day	1 week	2 weeks	4 weeks
1 finger	4	1	0	0
2 fingers	5	7	5	1
3 fingers	1	2	5	7
4 fingers	0	0	0	2

The table above shows how the mouth-opening abilities of patients in the control group changed over 4 weeks. The first measurement was taken on the first day after the immobilization was removed. We can observe that the largest number of patients (5 people - 50%) opened their jaws for 2 fingers on the first day (the range of motion was always measured with the patient's fingers). Four patients reached a minimum range of 1 finger, while one patient reached an above-average range of 3 fingers. After one week, seven patients (70%) managed to reach a 2-finger range, one patient still had minimal range of motion, and two (20%) managed to reach a 3-finger range. After two and four weeks, none of the patients had a 1 finger range of motion. After two weeks, study participants achieved ranges of 2 and 3 fingers - 5 in each range. It is worth noting that so far none of the patients has reached the maximum normal range of motion of 4 fingers. In the fourth week, the largest group of patients had a range of mobility of 3 fingers, only two managed to reach the pre-trauma state, one patient ended his progress with a 2-finger range.

Table 5. Evaluation of oral cavity movements in the sagittal plane in the study group

	Study group			
	1 day	1 week	2 weeks	4 weeks
1 finger	2	0	0	0
2 fingers	7	2	0	0
3 fingers	1	5	4	1
4 fingers	0	3	6	9

On the first day, the greatest number of patients obtained the range of mobility of 2 fingers (7 people – 70%), then the minimum range was obtained by 2 people (20%), and one person reached the range of 3 fingers. The first deviation from the control group after one week is the fact that none of the patients had a 1-finger range of mobility, and three people (20%) managed to reach normal mobility. Five people (50%) had a range of mobility of 3 fingers, and two had a range of mobility of 2 fingers. In the second and fourth weeks, there were no patients with a range of mobility less than 3 fingers. In the second week, 6 patients (60%) reached the normal state and four (40%) reached the range of 3 fingers. In the fourth week, however, only one patient had failed to normalize.

Evaluation of the possibility of protraction

Table 6. Evaluation of the possibility of protraction in the control group

	Control group			
	1 day	1 week	2 weeks	4 weeks
0 cm	7	0	0	1
0.1 cm	3	1	0	1
0.2 cm	0	7	0	0
0.3 cm	0	2	5	0
0.4 cm	0	0	3	1

After analysing the above table, it is noticeable that immediately after removing the immobilization, patients have a very big problem with the movement to place the lower incisors behind the upper ones. As many as 7 out of 10 patients cannot perform it. Only 3 patients (30%) achieved a minimum movement of 0.1 cm. After the first week, 1 patient still failed to perform protraction, 7 people (70%) achieved a movement of 0.1 (cm), and 2 people – 0.2 cm. After two weeks, 100% of people could perform protraction, 5 patients (50%) still remained at the minimum level of 0.1 cm, 3 patients (30%) performed protraction of 0.2 cm, and respectively 1 patient achieved 0.3 and 1 patient achieved 0.4 cm. After 4 weeks, the greatest number of patients achieved a distance of 0.3 cm, 3 patients (30%) achieved 0.4 cm, 2 subjects performed a protraction of 0.2 cm, and 1 patient still had minimal movement of 0.1 cm. It is worth noting that none of the patients reached their maximum range of motion.

Table 7. Evaluation of the possibility of protraction in the study group

	Study group			
	1 day	1 week	2 weeks	4 weeks
0 cm	3	0	2	4
0.1 cm	6	0	0	5
0.2 cm	1	1	0	1
0.3 cm	0	4	0	0
0.4 cm	0	3	0	0

In the study group, similarly to the control group, protraction after long-term immobilization is difficult to perform; 3 patients (30%) could not do it at all, 6 patients (60%) achieved the minimum range of 0.1 cm, and 1 patient – the range of 0.2 cm. After a week of physiotherapy, it is noticeable that each patient could perform protraction and only 1 to a minimum extent. Four patients (40%) achieved a result of 0.2 cm, three (30%) managed to place the lower incisors behind the upper incisors to a distance of 0.3 cm, and two (20%) to 0.4 cm.
After two weeks, 1 patient obtained the full normal range of mobility, followed by 5 and 4 patients obtaining the next lower results. In the fourth week, 50% of patients returned to their pre-injury fitness, and the other half achieved a result of 0.4 cm.

Evaluation of the possibility of performing side movements, right and left

Table 8. Evaluation of the possibility of performing right side movements in the control group

Control group. Right side movement				
Range	1 day	1 week	2 weeks	4 weeks
0–0.3 cm	6	1	0	0
0.4–0.7 cm	4	9	4	1
0.8–1.1 cm	0	0	6	8
1.2–1.5 cm	0	0	0	1

Table 9. Evaluation of the possibility of performing left side movements in the control group

Control group. Left side movement				
Range	1 day	1 week	2 weeks	4 weeks
0–0.3 cm	7	2	0	0
0.4–0.7 cm	3	7	5	1
0.8–1.1 cm	0	1	5	8
1.2–1.5 cm	0	0	0	1

We performed an analysis of right and left side movements once due to the fact that in the final phase all patients achieved symmetry of movements. The differences between these distances did not exceed 0.2 cm, which could result from measurement inaccuracies and was not significant for the study. On the first day after removal of immobilization, most of the patients had mobility in the range of 0–0.3 cm, and a smaller proportion of them had mobility in the range of 0.4–0.7 cm. After the first week, there was a noticeable upward trend - most of the patients could perform side movements in the range of 0.4–0.7 cm. In the second week, in comparable proportions, half of the patients achieved 0.4–07 cm and the other half 0.8–1.1 cm. It is worth noting that only one patient achieved the maximum range of mobility after 4 weeks, and the largest number of patients achieved the range of 0.8–1.1 cm.

Table 10. Evaluation of the possibility of performing right side movements in the study group

Range	Study group. Right side movement 1 day	1 week	2 weeks	4 weeks
0–0.3 cm	5	0	0	0
0.4–0.7 cm	4	2	0	0
0.8–1.1 cm	1	6	2	0
1.2–1.5 cm	0	2	8	10

Table 11. Evaluation of the possibility of performing left side movements in the study group

Range	Study group. Left side movement 1 day	1 week	2 weeks	4 weeks
0–0.3 cm	4	1	0	0
0.4–0.7 cm	5	0	1	0
0.8–1.1 cm	1	7	1	1
1.2–1.5 cm	0	2	8	9

We conducted a similar analysis of the above tables in the study group, although one of the patients did not manage to achieve motor symmetry during the study period, which was caused by the occurrence of inflammatory complications during treatment. As in the control group, the greatest number of patients had a range of mobility of 0–0.3 cm and 0.4–0.7 cm. A visible deviation from the control group is the fact that after one week, two patients achieved a normal range of motion, most of them within 0.8–1.1 cm. After the second week, 8 patients (80%) achieved the normal range of motion, and in the fourth, almost all but the patient with a complication (left side movement slightly decreased in the range).

Table 12. Evaluation of pain upon palpation in the control group

Pain	Control group 1 day	1 week	2 weeks	4 weeks
Occurs	6	3	1	0
Does not occur	4	7	9	10

Evaluation of pain upon palpation

The table above shows that 6 (60%) of 10 patients experienced pain on palpation on the first day after removing immobilization. After the first week, 7 patients (70%) did not feel any pain. After 2 weeks, only 1 patient reported pain. At week 4, 100% of the patients had no pain.

Table 13. Evaluation of pain upon palpation in the study group

From the table above, it can be seen that only 2 patients (20%) from the study group experienced pain on palpation on the first day after removing immobilization. After the first and se-

cond weeks, 9 out of 10 patients were pain free and by the fourth week 100% of patients were pain free.

Table 13. Evaluation of pain upon palpation in the study group

Pain	Study group 1 day	1 week	2 weeks	4 weeks
Occurs	2	1	1	0
Does not occur	8	9	9	10

Discussion

Physiotherapy after mandibular fractures still constitutes an unknown subject for the vast majority of doctors and patients. It should be noted that rehabilitation in dentistry and cranio-maxillofacial surgery is not popularized, and the only available literature concerns physiotherapy in diseases of the temporomandibular joint. Mandibular fractures are the most common fractures of the facial bones of the skull – approx. 66%. The mandible is physiologically adapted to heavy loads, however, due to the lack of shielding by other bones and its anatomical position, it is predisposed to injuries [3, 4]. The epidemiological data shows that in men, mandibular fractures are much more frequent than in women – the ratio is 5:1. The mandible is most often fractured in young people aged 21–30 and 31–40, who are most professionally and socially active [5, 6, 7, 8]. Buttner points out that the reason for its low popularity may be the shortage of qualified physiotherapists [8]. He emphasizes that the appropriate early physiotherapy gives patients tangible benefits, significantly contributing to the reduction of treatment time and faster improvement of the patient's psychophysical condition.

Dr. Magdalena Piechta notes that the interest in physiotherapy in dentistry has increased recently. In order to broaden the knowledge in this field, symposia and trainings on the dysfunction of the masticatory organ are held, which facilitates and enables establishing cooperation between physiotherapists and dentists [9].

It is well known that physiotherapy after fractures in orthopaedics and traumatology is the standard of care. Taking into account the fact that the probability of complications following immobilization in both orthopaedics and cranio-maxillofacial surgery is similar, both groups of patients should have the same chance of receiving the needed help from physiotherapists.

Dziak and Zembaty emphasize that the planned rehabilitation program should be individually selected and adjusted to each patient, taking into account the type of fracture and the surgical procedure. The aim of rehabilitation is to activate and verticalize the patient as soon as possible, which will minimize the likelihood of complications from the respiratory or circulatory system. This procedure applies to patients of all age groups, however special attention should be paid to the elderly, who are at greater risk of side effects of immobilization due to their multiple comorbidities. Therefore, efficient implementation of the rehabilitation plan will avoid both local complications (necrosis, pseudo-joint formation) and general complications [10, 11].

Woźniewski, referring to the standards of *Physiotherapy in oncology*, writes about the standards of treatment in oncology and states that a physiotherapy program should be one of the basic elements implemented at an early stage of hospital treatment [12].

Mgr Agnieszka Guzik, MA, in her study *New directions in physiotherapy in people after stroke* presents the benefits of using physiotherapy in neurological patients, which takes into account the prevention of consequences of limited activity and immobilization. She mentions that there is scientific evidence of the physical and functional benefits of involving neurological patients in physical activity [13].

In each of the above-mentioned branches of medicine, physiotherapy is generally available to patients, the choice of methods is wide, individually planned for the patient, and physiotherapists know exactly how to conduct therapy.

Patients after mandibular fractures treated in the clinical department of cranio-maxillofacial surgery were surprised that they were offered rehabilitation. Their problems, however, are just as important as the problems of the above-mentioned oncological or neurological patients. They can lead to limitations in everyday life and in functioning in society. By analysing the results of our study in the control group and the study group, one can easily notice the difference between them. Patients who participated in physiotherapy returned to full fitness after two weeks, and patients who refused to exercise (control group) struggled with many mobility limitations even 4 weeks after removing immobilization. This shows the scale of the problem and the need to further explore and popularize the use of physiotherapy after mandibular fractures. The obtained results showed significant differences between patients who underwent physiotherapy after mandibular fractures and those who did not want to participate in it. These differences are visible just one week after the introduction of kinesitherapy and elements of manual therapy. This allowed for the conclusions to be made that the problems of patients after immobilization due to mandibular fractures are significant and should constitute a starting point for the development of an appropriate physiotherapeutic treatment algorithm for these patients and promote physiotherapy as a standard of care in such cases.

To sum up, rehabilitation of patients after orthopaedic and surgical-orthopaedic treatment of mandibular fractures is still a little-known field of science, but it is known that early introduction of physiotherapeutic procedures plays a very important role in rehabilitating patients after each surgery. It facilitates, and sometimes even enables a return to normal social and professional life.

Conclusions

1. On the basis of selected methods of physiotherapy, especially kinesiotherapy in connection with anatomical conditions within the facial part of the skull, we have developed an original set of exercises for patients with mandibular fractures who were treated with orthopaedic and surgical-orthopaedic methods.
2. The application of the exercise regimen developed by us for patients after orthopaedic and orthopaedic-surgical treatment

of mandibular fractures resulted in much faster recovery of the stomatognathic system compared to the control group.

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