

GEOTERMÁLNÍ VODA POUŽÍVANÁ PŘI LÉČEBNÉ REHABILITACI. VODNÍ ZDROJE V POLSKU PRO PACIENTY S PORUCHAMI POHYBOVÉHO APARÁTU. ZNALOSTI PRO FYZIOTERAPEUTY

GEOHERMAL WATER USED IN MEDICAL REHABILITATION. WATER RESOURCES IN POLAND FOR PATIENTS WITH LOCOMOTOR SYSTEM DISORDERS. KNOWLEDGE FOR PHYSIOTHERAPISTS

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SUMMARY

The period of human life can be divided into three phases. If there are not any symptoms of primary pathology, a rapid development, proper shaping and growing is observed in newborns, infants, children and adolescents. Anabolic processes prevail.

The early adult life – from 20 to 50 years of age – is a phase of full activity, good health, with pre-dominance of anabolic processes.

From around the age of 50, a period of slow domination of catabolic, regressive, processes begins, leading to dysfunctions and diseases. The suffering of older people is caused by diseases and dys-

functions of the spine, hips, knees, feet and shoulders. These processes can be slowed down or even inhibited by the appropriate rehabilitation. The best conditions for therapeutic rehabilitation are in geothermal waters. In the article we inform where there are Geothermal Rehabilitation Centers in Poland and where geothermal waters are potentially easy to obtain. The use of these waters is a task for the Polish population, doctors, physiotherapists, the Polish Geothermal Association and of the Polish Government.

Key words: orthopaedics, neurology, disorders, deformations, illnesses, physiotherapy using geothermal water.

INTRODUCTION

From the beginning of human history, there have been and there are incorrect developments, disorders, diseases, pain syndromes, trauma of movement apparatus and other forms of motor disability. Medical help for suffering people was constantly needed. In antiquity – there were medics [Latin “medicus” – doctor] and barbers – later surgeons. From 1741 – after the publication of the book: *L'Orthopédie ou l'art de prévenir et de corriger dans les enfants, les difformités du corps le tout par des moyens à la portée des pères & des mères & de toutes les personnes qui ont des enfants à élever* by Prof. Andry Nicolas, royal physician from Paris – the word “orthopaedics” became known. The word “orthopaedics” comes from two Greek words – orthos – straight, correct and pais – child. Rehabilitation and physiotherapy as parts of medicine are derived from orthopaedics over the next centuries.

Already in antiquity, the warmth of water was valued as a treatment. Emperor Agrippa first used the term “therms” (Latin “thermae”) for pools in which health was recovered in warm waters. Nowadays we can say – they were “geothermal baths” or “medical gymnastics in geothermal water”. In Poland prof. Julian Sokolowski and prof. Jacek Zimny were the first scientists speaking about using of geothermal water also in medical therapy (**Fig. 1a, 1b, 3, 7, 8, Tab. 1**).

Soaking in geothermal, mineral water is good for the mind, body and soul. Here are some reasons why it feels so good. Is good for our skin, while our bodies are covered in a protective shield that's also porous. Skin absorbs what surrounds it, the good and the bad. The waters contain minerals that can detoxify and can help remedy skin ailments. So soaking can be beneficial to your skin. Skin will feel fresh, clean, and be aglow. The second role is the heat. The warmth of hot water can help alleviate pain sensations. Science has shown that soaking in hot water blocks pain receptors in bones and muscles. Next is the good vibes. While it's tempting to drift into a serene solitude while soaking in geothermal warm water, it's also a great place to connect with others. People gather in the warmth to visit, catch up, share and collaborate. And we all know how important it can be to our wellbeing to stay connected to others. Then relaxation and the clarity. Soaking in warm water can be deeply restorative. It can help reduce stress, bring a sense of peace and serenity. And by combining a warm soak with a cooling experience like our cold plunge, you're upping your chances of a great night's sleep. The heat of our water combined with minerals helps release nasal and lung congestion in powerful ways. You'll emerge breathing clearly and deeply. Spending quality time in warm waters is good for us, on the inside and the out.



Fig. 1a, 1b. Prof. Julian Sokołowski (1932–2004) (Fig. 1a) – initiator and creator of „Polish Geotherms“. Prof. Jacek Zimny (Fig. 1b) – professor at Akademia Górniczo – Hutnicza (Polish) / University of Technical Science (English) – continuator of „Polish Geotherms Program“.

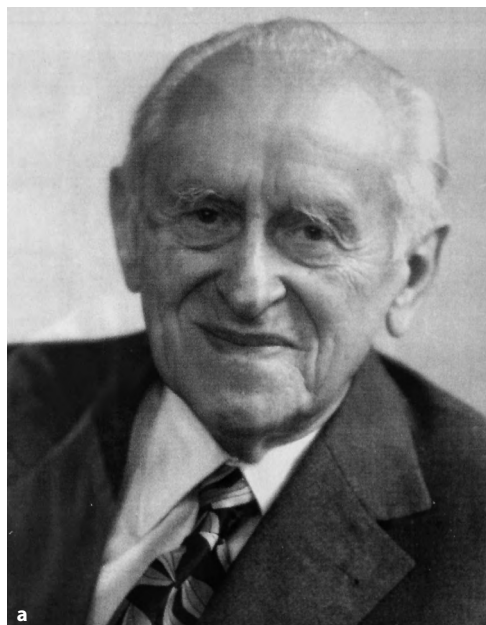


Fig. 2a, 2b. Prof. Wiktor Dega (Poznań) (fig. 2a) had spoken – in physiotherapy important knowledge and sensible heart. Prof. Stanisław Piątkowski (Lublin) (fig 2b) had spoken – good rehabilitation doctor only after successful study of orthopedics.



Fig. 2c, 2d. Prof. Józef Kamiński (Lublin) (fig. 2c) had spoken – good results in therapy if the doctor is fully educated in orthopedics. Prof. Ignacy Wośko (Lublin) (fig. 2d) had spoken – of a no good doctor if not properly educated and even more worse if „overeducated”.

CAUSES OF PATHOLOGY

Causes of pathology – of developmental disorders in children and pain syndromes in adults. In orthopaedic and rehabilitation literature as well as in medical practice, it is most often assumed that the pathology of the musculoskeletal system is associated with “muscle weakness” and “strengthening” is recommended as a treatment. This concept is probably adopted from sport – where strong muscles mean better results in jumping, running or other disciplines. But that does not happen in medicine. The pathology of the musculoskeletal system in children and adults is associated mostly with limitations in the range of movement of the joints and incorrect positions of parts of the body. These disorders are the result of shortening of muscles, tendons, fascia and joint capsules – symptoms typical for the Syndrome of Contractures and Deformities [SofCD] according to Prof. Hans Mau (52) and Lublin observations from the years 1973–2021 (25, 28). We observed also other groups of patients with – shortening of muscles, tendons, fascias, capsules – and there are cases with symptoms of Minimal Brain Dysfunction [MBD]. In these neurological abnormalities we observed sub-spasticity of the muscles and very often laxity of joints as a result of “unprofitable biochemical changes of the collagen”. In cases of MBD there are deformities in children and pain syndromes in

adults. Shortenings in orthopaedics are called “contractures” (Latin contractura / plural – contracturae). It is a concept presented by the Poznań and Lublin orthopaedic team since 1960s–70s – by prof. Wiktor Dega, prof. Stanisław Piątkowski, prof. Ignacy Wośko, prof. Józef Kamiński (**Fig. 2a, 2b, 2c, 2d**) – but also by professors of orthopaedics abroad – Prof. Jørgen Reimers (Denmark), Prof. Harald Thom, Prof. Hans Mau, Prof. Hans Zwipp, Prof. Britta Fuchs (Germany). Prof. Viktor Bialik (Israel), Prof. Tibor Vizkelety, Prof. Kalman Szepesi, Prof. Janos Rigo (Hungary), Prof. Ivo Marik (Czech Republic), Prof. Mikhail Dudin (Russia), Dr. Piet van Loon (Netherlands) and many others.

Necrosis of the femoral head in children – known as Perthes’ disease, is also associated with MBD. In MBD there are not only changes in the anatomy and function of the musculoskeletal system (References **23, 26, 27, 29, 31, 38, 39, 40, 41, 59**), but also appears in many children some as psychological changes. Children with MBD mostly are restless, anxious and nervous and like to jump. Repeated jumping on a hard surface for weeks and months leads to fractures of the trabeculae of the femoral head – this starts the process of Perthes disease. The illness can last over 3–5 years. This process we described in 2021 in an article: Perthes disease. Etiology. Symptoms. Physiotherapy. In the International Journal of Orthopaedics Research, USA / Kansas, 2021, Pages 1–7 (**48**).

In all cases with symptoms of Minimal Brain Dysfunction [MBD], with all contractures of joints, with all symptoms of “incorrect position of parts of the body” – the best therapy is stretching exercises in geothermal water. Such therapy can cure all contractures, correct posture of all parts of the body and improve function.

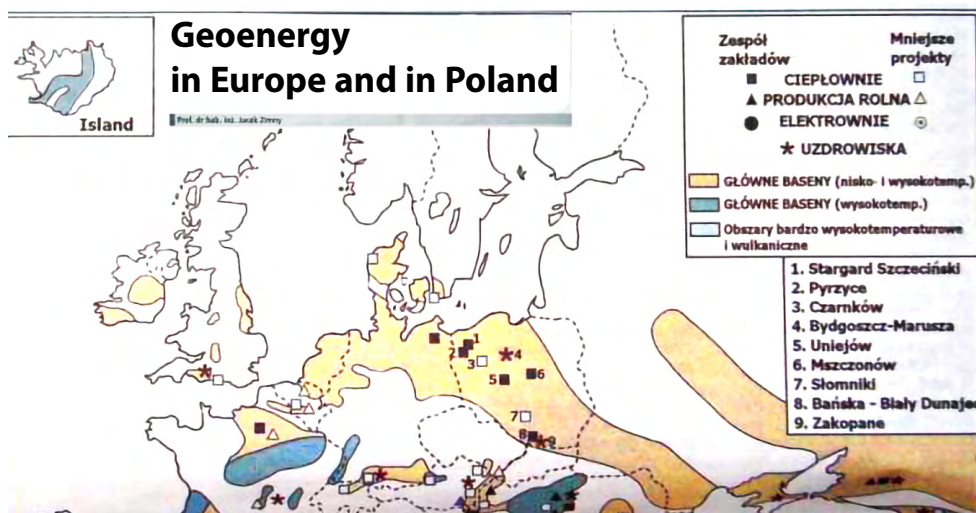


Fig. 3. Publication by Prof. Jacek Zimny of an article about the „Energy of geothermal water in Europe and in Poland”. Big resources of geothermal water – chance for the development of many Rehabilitation Centers in Poland.

MATERIAL

The group of patients, which is described in this study, includes many hundreds of patients treated by the authors – T. Karski since 1961, M. Domagała since 1979, J. Karski since 1989 and K. Karska since 2010. The conclusions contained in this study are also based on observations concerning the effectiveness of treatment in geothermal water in Hungary, because in the years 1961–2000 suffering people were directed to Hungarian Geothermal Rehabilitation Centres. At that time, the knowledge of prof. Karoly Papp, prof. Kalman Szepesi and prof. Janos Rigo from the University Orthopaedic Department in Debrecen had for us a very important value. Thanks to the activity of prof. Karoly Papp – geothermal water lead directly to the building of Houses for the Orthopedic Department, to make it easier for rehabilitation exercises in Hospital (personally observation by T. Karski in the years 1968–1978).

CHILDREN AND ADOLESCENTS – REVIEW OF DISEASE

Already in newborns and infants, disturbances in anatomy and function of joint, as well as development and growth may occur. These disorders – as mentioned earlier – had been described by Prof.



Fig. 4. Szaflary in Podhale – south region of Poland. Rehabilitation exercises in geothermal waters are especially profitable in locomotors system disorders. Photo T. Karski (2019).



Fig. 5. Bukowina Tatrzańska – mountain region of Poland. Rehabilitation exercises in geo-thermal waters give the best results in the therapy of locomotor system disorders. Photo T. Karski (2009)

Hans Mau (Tübingen) called these anomalies in German “Siebenersyndrom” – in English “Syndrome of Seven Contracture”. It is a pathology concerning the anatomy, positioning of individual parts of the body and the range of joint mobility. In Lublin, the pathology and the resulting disorders – in form of deformities, insufficiency in function we called “Syndrome of Contracture” (SofC) since 1973 – after T. Karski’s scholarship in a program of DAAD at the University Orthopaedic Department in Heidelberg and in Essen and J. Karski – after a scholarship at the Orthopaedic Department in Heidelberg in 1995. In 2006 in Lublin – the eighth pathology related to shank varus deformity was added to the “Seven Contracture Syndrome” (T. Karski and J. Karski). Since then, from 2006, in Lublin this syndrome we called “Syndrome of Contracture and Deformation” (SofCD). This, described in 2006 pathology – if not treated or treated ineffectively, can lead to a deformity called “Blount’s disease” (References **26, 27, 28, 29, 33, 34, 38, 39, 40, 41, 42, 43**).

Another group of pathologies in the form of deformation in children and pain syndromes in adults – are resulting from a pathological function of the Central Nervous System [CNS]. This pathology is known as Minimal Brain Dysfunction [MBD]. The MBD arises mostly as a result of asphyxia in the foetal or perinatal period (References **26, 29, 31, 39, 41, 42, 44**). These early pathologies require early treatment – and such therapy we can see as “prophylaxis for adult people”.

Thus – according to the authors – two groups of primary pathologies’ are in children about 30% – 40% and the same percent – of diseases and pain syndromes in adults. There are, of course, other causes of pathologies of the musculoskeletal system which require differential diagnosis and special treatment methods.

Here we present some pathologies of the musculoskeletal system – in children, adolescents and adults, requiring treatment, preferably through stretching exercises in geothermal water.

A. Hip dysplasia – this pathology may have a different aetiology:

- a) may be one of the symptoms of the Syndrome of Contracture and Deformation (SofCD),
- b) may be associated with laxity – it is a neurological factor of MBD associated with pre- or perinatal asphyxia,
- c) may be due to spasticity or sub-spasticity of the hip adductors – it is also a neurological factor of MBD.

A common feature of hip dysplasia is contracture (shortening) of the hip adductors, sometimes joint instability (**12, 13, 22, 23, 24, 27, 29, 31, 39, 40, 43**). Treatment consists in overcoming contracture of the hip adductors, which becomes easier in geothermal waters (**20**). Abduction nursing is neces-

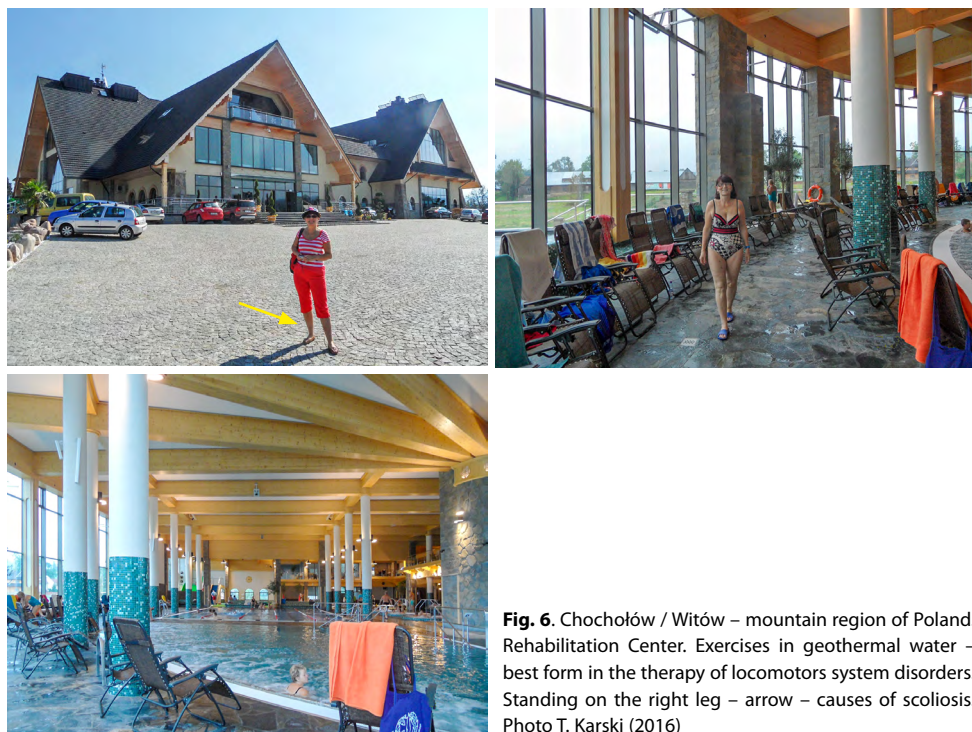


Fig. 6. Chochółów / Witów – mountain region of Poland. Rehabilitation Center. Exercises in geothermal water – best form in the therapy of locomotors system disorders. Standing on the right leg – arrow – causes of scoliosis. Photo T. Karski (2016)



Fig. 7. Map of Poland. Coloured fields – geothermal waters in Poland. White fields – geothermal area not recognized. Prepared by: R. Ney, J. Sokołowski. J. Zimny. Geothermal Rehabilitation Centers – the future for Poland.

sary from birth to the end of the first year of life, sometimes longer. Recovering from hip abduction after being carried by mother or father is faster, more effective and pleasing to the baby in geothermal waters. Due to its influence on the circulatory blood system, warm water effectively protects the hip against possible complications – such as aseptic necrosis of the femoral head. Such treatment is particularly important in children with primary symptoms of MBD. Please note – carrying babies facing to the front, without hip abduction – is a mistake, unfortunately common practice currently in many countries in Europe .

B. Torticollis – this pathology may have the following causes:

- a) may be a symptom of Contracture and Deformation Syndrome,

- b) may be the result of a traumatic delivery,
- c) may be congenital as a torticollis cum tumor neonatorum.

The treatment consists in overcoming the contracture of the muscle sternocleidomastoid by stretching – rotation therapy – by twisting the child's head towards the torticollis (!). This rotation stretching has been used in Lublin since 1974 and many years of observations confirm that this method is fully effective. This method of therapy was published in many articles – in 1991 in Orthopädische Praxis in Germany (Reference **5, 13**) and in 2015 in the American Research Journal of Medicine and Surgery. Also, in the following years, in other journals in the USA, England and in the Czech Republic (Reference **28, 29, 33, 39, 40, 41, 54, 58, 59**). Here we want to underline that only “the rotation by stretching to the torticollis side” is fully optimal therapy. In our opinion, the effectiveness of the treatment of torticollis in geothermal waters by rotation stretching is much faster and more effective. Using this method in physiotherapy brings beneficial effects not only in new-borns and infants, but also in 3–4 year old children. However, good cooperation between the physiotherapist and the parents is necessary.

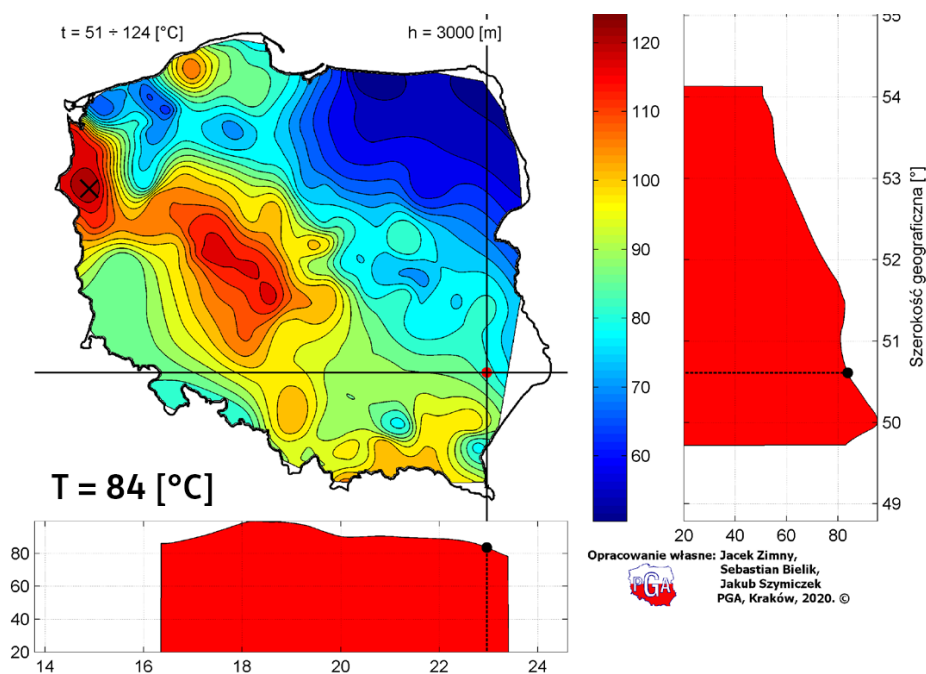


Fig. 8. Zwierzyniec – town in the southern part of Lublin District. Geothermal waters to a depth of 3000 m with a temperature of water 84 °C. The map was prepared by Prof. J. Zimny and his team.

Location	Borehole depth [m]	Temperature of water [°C]
Zwierzyniec	Prepared by J. Zimny, K. Szczotka, M. Strus	Prepared by J. Zimny, K. Szczotka, M. Strus
Roztocze Zwierzyniec	500	28
	1000	39
	1500	50
	2000	61
	2500	72
	3000	84
	3500	95
	4000	106
	4500	117
	5000	128

Tab. 1. Geothermal Water in Zwierzyniec. Beneficial depth of 3000–3500 m.

C. Foot deformities. Valgus, flat-valgus deformities of the feet are most often the result of shortening of the triceps muscles (Latin M. triceps surae [MTS]) and Achilles tendons in cases of MBD. Such pathology affects approximately 13% of children in Poland (References **4, 5, 6, 7, 8, 9, 10, 11, 14, 16, 17, 18, 38, 39, 40, 41, 42, 43**). The most common causes of MBD are, as mentioned before, the asphyxia of the foetus during pregnancy or delivery. Treatment is based on stretching, that is elongation of the Achilles tendons and the musculus triceps surae. Treatment in geothermal waters is the most effective.

D. The so-called idiopathic scoliosis. For over two thousand years, the aetiology / causes of these spinal deformities were unknown. Observations made in Lublin (1984–2007, and particularly 1995–2007) indicate that scoliosis are a result of the impact of biomechanical factors in the situation of primary asymmetry of movements and positioning of the hip joints and the pelvis itself. In children with scoliosis, restriction of adduction in the extension position of the joint is found in the right hip. A loss of internal rotation of this joint is often also present. Sometimes there are flexion contractures in both hips, as a symptom of MBD, causing an anterior tilt of the pelvis which makes development of spine deformity easier.

Hip movement asymmetry is a part of the symptoms, Syndrome of Contracture and Deformation (Prof. H. Mau and Lublin observations) (**35, 38, 39, 40, 41, 42, 43**).

In the development of scoliosis plays two biomechanical factors – a) permanent standing “at ease” on the right leg and b) walking. Standing – because the right hip is more stable and standing is easy and safe. Walking – because fully limited movement of the right hip is forced to make walking compensatory movements of the pelvis and spine – leading to rotation deformity and stiffness of the spine.

The aim of the therapy – is to receive full movement of the right hip, proper position of the pelvis and full movement of the spine. Stretching exercises are the only proper therapy of scoliosis – and these preferably – in sport and in geothermal water. Only the flexion and rotation exercises are the correct form of therapy. Prof. Stefan Malawski (Warsaw, Otwock) was the first in Poland to approach this issue. It is necessary to point out that sports such as karate, aikido, taekwondo, tai chi, kung-fu, yoga, which involve elements of stretching are an excellent method of causal prophylaxis and therapy of scoliosis.

ADULTS – REVIEW OF DISEASES

In adults, the problem is pain, most often in the spine, hips, knees and shoulders.

A. Spine. In adults and rarely in adolescents – “back pain syndromes”, other descriptions: “discopathy”, “lumbar spine stenosis”, “lumbar disc hernia” are really caused by:

- a) lumbar hiperlordosis – due to hip flexion contracture in persons with MBD,
- b) due to degenerative scoliosis in type – “S” 1st etio – patho – genetic group / type (epg) – starting already in childhood as “C” or “S” type in 2nd A/B epg group,
- c) due to the stiffness of the spine – this is a specific type of “I” scoliosis in the 3rd epg group in the Lublin classification (this type of scoliosis was described in 2004 – T. Karski),
- d) spondylolisthesis,
- e) congenital defects of the spine and / or chest,
- f) other, rare genetic causes or disease syndromes.
- g) the rapid cooling of the peri – spinal soft tissues during intense work or sport (observation from 2018 – T. Karski).

Neurosurgeons recommend mostly surgical treatment in the case of back pain, usually diagnosing “prolapsed nucleus pulposus”. The authors’ experience says (**19, 21, 25, 26, 27, 28, 29, 32, 34, 38, 40, 41, 42, 43, 44, 55**) that surgical treatment does not bring the expected results and only physiotherapy proves to be important and effective. These observations were also confirmed in scientific discussions by T. Karski with Prof. K. F. Schlegel – (Head of the Orthopaedics Department in Essen, Germany – T. Karski in scholarship programs of DAAD was in Essen’s Orthopedic Department in 1973) – during meetings at Orthopaedic Congresses in the years 1975–1980. Our recommendations (Reference **38, 43, 44, 45**) for the patients with “Back pain” are: physical methods of therapy: “chair extension” and exercises in geothermal water. Over the many years of observations we could confirm that kinesio-therapy in mineralised warm waters is easy to do and very effective. Contractures in the area of the hips, pelvis and spine are easier to overcome in geothermal waters. Fully, no restricted function of the spine – means life without pain. As previously underlined, geothermal waters have a great analgesic effect. After rehabilitation exercises in geothermal waters good health conditions as well as “positive mental thinking” – return faster.

B. Hip. The hip joint in adults is often the site of pathology. The authors refer to the initial stages of the disease as “imperfect hips” (References **2, 15, 40, 41**). The advanced disease is “hip arthrosis”. Left hip arthrosis is usually the result of dysplasia, which has not fully healed in childhood. Right hip arthrosis – this is very often the result of permanent standing ‘at ease’ on the right leg. This pathological phenomenon occurs in the “Right Leg ‘at ease’ Standing Syndrome”. This syndrome is a medical observation from 1997, when the aetiology of the so-called idiopathic scoliosis was described (1995–2007, T. Karski). There are numerous publications of ours about “Right Leg Standing Syndrome”, mostly in the USA (References **22, 30, 31**). In the “Imperfect Hip Syndrome” and particularly in “hip arthrosis” the symptoms include – loss of the full range of movements, anatomical changes of the femoral head or both femoral heads, and even their necrosis process and, as a result – pain, difficulty walking, limping and disability. According to many authors, the loss of mobility of the hip joint alone, as “only this one symptom” can lead to hip pathology. These observations made in Lublin (T. Karski, J. Karski) is also recognised by many foreign authors, including professor Britta Fuchs from the Medical University of Idstein, professor Hans Zwipp from the Orthopaedics Department in Dresden (Germany) (**30, 31, 34, 35, 38, 39, 40, 41, 42, 43, 55**). Treatment should primarily include recovery of abduction, internal rotation, and extension of the hip or both hips. Geothermal water stretching exercises are the best and most effective.

C. Knee. Knee problems in adults are associated with primary axis disorders – persisted from childhood – varus of shanks or valgus of the knees in older children, youth and adults. Both defects make pain and difficulties in walking – because of instability of the knee joint. Another cause of pathology is knee contracture – even small 3–5 degrees. A large group of patients have problems with the patellofemoral joint, when the patella is in its lateral position; there is a subluxation of the patella, symptoms of chondromalacia and patello-femoral arthrosis.

A large group of patients have knee problems associated with incorrect sitting. It is a common pathology, but its recognition and descriptions come only from the years 2012–2021 (T. Karski, J. Karski, M. Domagała) (References **35, 37, 38, 46**). Treatment of knee pain syndromes is very effective and beneficial when performed in geothermal waters. Many years of observations confirm that in warm water, exercises to improve knee stabilisation, to remove the pain – are a pleasant and effective form of therapy.

D. Feet. There are many diseases, deformations leading to foot dysfunction and pain syndromes (References **4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 35, 36, 37, 38, 47, 49, 53, 55**) and we present a list of “feet problems”:

1. Pes plano-valgus,
2. Hallux valgus,
3. Foot insufficiency and foot pain in neuro-muscular dysfunction (MBD),
4. Chronic rotational distortion syndrome of the talocrural joint (References **35, 36, 37, 38, 3–36, 47, 52**)
5. Morton’s pain syndrome (References **47, 52**),
6. Köhler II disease (References **47–52**),

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7. Pathology resulting from the loss of plantar flexion of the toes. In the diagnosis of this dysfunction, the flexion test of the toes is important (References **4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 55**).

The radiating pains to the shank and the foot – can appear in degenerative scoliosis and lumbar hyperlordosis. Here – we underline – the differential diagnosis in “foot pain syndrome” – is necessary.

All the above – described deformities and foot dysfunctions can be successfully treated by exercises in geothermal waters. Rehabilitation in warm, mineralised water in order to regain stabilisation and increase the range of motion of the foot joints, plays an important role in improving the foot functions and at the same time has an effective analgesic effect.

E. Shoulder. Shoulder dysfunction is a common disorder for many people. The cause of pain syndromes – bearing various names, such as “painful shoulder contracture”, “frozen shoulder” or “pain syndrome in the acromial region” – is known and described in many orthopaedic publications. Two main reasons are important in shoulder pathology according to our observations.

The first group of causes is pathology related to professional work performed “above the shoulder joint level” – e.g. car mechanic, housework – washing windows, stacking shelves, working in shops, warehouses, etc.

The second group of causes is related to overload and ischemia of the attachments of the muscles of the shoulder region and also often of the neck while working, when the muscles of the shoulder and neck are in constant isometric contraction – without any movement of the joint. This leads to ischemia and sometimes local minimal necrosis of the attachment of the muscle or certain regions of the muscle itself, and these symptoms are referred to as “enthesopathy”. Very often, when the persons are working on a computer – the shoulder and neck muscles – m. trapezius, m. deltoideus, m. subscapularis, m. supraspinatus, m. infraspinatus – are in “contraction” and can appear ischemia in some parts of the tendons or muscles which triggers pain. Pain, makes the movement impossible. This results in a “shoulder contracture”, referred to in situations of maximum pathology as “frozen shoulder”. Treatment of shoulder pain syndromes is to improve circulation, regain movement, and the most effective way is exercises in geothermal waters. The therapy of “shoulder problems” especially “frozen shoulder” can take sometimes many years. In the past, patients were sent to geothermal waters in Hungary, now such therapy can be implemented in Poland.

BENEFICIAL PROPERTIES OF GEOTHERMAL WATERS

The beneficial effects of geothermal waters in physiotherapy are based on three essential elements:

1. warm water with a temperature of 36 or 38 degrees is an excellent analgesic in pain syndromes, and at the same time an essential anaesthetic,

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2. water provides – according to Archimedes' law – buoyancy, offering the perfect possibility of kinesiotherapy.
 3. minerals (**Fig. 4**) in geothermal waters are an important element for tissue reconstruction, for all anabolic, nutritional and regenerative as well as energy processes important in our every day activity, in physical work and in sport.

TREATMENT FOR DISORDERS OF THE MUSCULOSKELETAL SYSTEM IN GEOTHERMAL WATERS, ESPECIALLY FOR OLDER PERSONS.

Spine – recovery of flexion and extension movements, left and right deviations, as well as left and right rotation as the basic task. Recovering these movements in geothermal waters is easier, faster and more effective.

Hip – recovering abduction, internal rotation, and extension are essential tasks for every older person as a prophylaxis against arthrosis of the hip. The best results are obtained if the exercises are performed in geothermal waters.

Knee – Exercises in geothermal waters to improve the stability of the knee or to remove its flexion contracture are easy, more effective, pleasant and painless. As mentioned above, geothermal waters have an analgesic effect.

Foot – two areas of the foot require kinesiotherapy in geothermal waters – talocrural joint to recover dorsiflexion of the foot and plantar flexion of the toes. Only full and painless movements of the foot in the talocrural joints and flexion of the toes, ensure a painless and efficient locomotive function.

Shoulder – shoulder dysfunction and pain syndromes are the complaints of many middle – aged and elderly people. The therapy must be persistent for a long time and should achieve two goals. The first goal is to make the movements painless – and this is possible in geothermal waters. The second goal is to regain full abduction movement, external rotation as well as shoulder extension. Recovery through exercises such as “pendulum exercises” (Latin “manus pendula”) with the limb pointing downwards (hanging) in geothermal waters is faster and more effective.

GEOTHERMAL WATERS IN POLAND

Location – information on where to build new rehabilitation centers with the use of geothermal waters (**Fig. 3, 4, 5, 6, 7, 8, Tab. 1**).

The authors (T. Karski, J. Karski, M. Domagała, K. Karska) know from their own medical observations many Geothermal Centers in Hungary, Slovakia and in Poland. A cooperation with the AGH (Polish:

Akademia Górniczo – Hutnicza) – (English: University of Science and Technology [UST]) from Kraków started in 1995 and it was a cooperation with Prof. J. Sokołowski until 2004 and currently with Prof. J. Zimny and his team (References **55–59**) (**Fig. 1**).

We known personally the Geothermal Rehabilitation Centers in the Tatra Mountain District – a district south of Poland in Białka Tatrzańska, Bukowina Tatrzańska, Szaflary and Chochółów (**Fig. 4, 5, 6**). Now the aim of our cooperation is to organize new Geothermal Rehabilitation Centres in other parts of Poland for example in the Rostotcze Region (Zwierzyniec District). According to literature, Poland is the country to have the largest area of geothermal waters “under its surface”. Professor Julian Sokołowski (1932–2004) – the Father of Polish Geotherms – during many Scientific Conferences and Sessions used to say “there is another Baltic with warm water under the Polish soil”. The temperature of geothermal waters depends on the borehole depth and appropriate values are presented for the village of Zwierzyniec in Rostotcze (**Table 1, Fig. 9, 10, 11, 12, 13, 14**). Polish geothermal waters have full mineral resources important for every human organism for its functioning, health and fitness. As an example, the mineral composition of Białka Tatrzańska in Podhale is provided (**Fig. 4**).

DISCUSSION

Benefits of thermal water is well documented. Kecskés inform about situation in Hungary. Owe to the favourable geological circumstances Hungary is, in both thermal and medicinal waters, a rich area of the world. The medicinal waters based spas, with the joined (medicinal) treatments play important part in the health protection and in the process of cure and recovery (**51**). Many authors confirm benefits of thermal water in different aspects in prophylaxis and rehabilitation of moving apparatus (**1, 3, 50, 55, 56, 57**). In this article authors confirm benefits in patients requires different, special treatment. We speak about the young patients affected by disorders of growth and destroyed development and older patients suffering because of “pain syndromes”. In orthopaedics and rehabilitation knowledge persist the opinion that “muscle strengthening exercises” are the best solution in the therapy. The opinion of general doctors, proclaim that analgesic drugs alone will relieve pain and insufficiency of movement apparatus in suffering people.

The authors of this publication claim that pathology, including pain syndromes, is usually associated with deficiencies in joint movement, faulty positions of the body parts, faulty loading and overstress during work or sports. Mostly these pathological symptoms are connected with shortening of soft tissues – fascias, tendons, muscles, capsules – and only stretching exercises are proper in the therapy. All these “shortenings” we call in orthopaedics “contractures”. In therapy of “contractures” the best are stretching exercises – and the profitable exercises are in geothermal water. Also some kind of sport has the stretching elements. In this group is karate, aikido, taekwondo, or yoga. But in our opinion the stretching exercises in geothermal waters are “the best under discussion”.

There are geothermal waters under the Polish soil – they only need to be brought to the surface and used, not only for industrial purposes, for heating houses, schools, offices, hospitals, factories,

public institutions, electricity production, but also for rehabilitation therapy and prophylaxis. This can happen through the development of Geothermal Rehabilitation Centres for Polish citizens and for patients from other countries of Europe.

CONCLUSIONS

1. Pathology of the musculoskeletal system in the form of deformities in children and adolescents and pain syndromes in adults are very common – 15% of children and 30% of adults.
2. The most common locations of pain are the spine, hips, knees, feet and shoulders.
3. The causes of pathology are connected mostly with loss of movement in joints – called “contractures of joints”, with instability of joints, overstress in professional activity, in sports and in everyday domestic work.
4. The primary cause are pathologies described as “Syndrome Contracture and Deformities” (Prof. Hans Mau) and “Syndrome of “Minimal Brain Dysfunction” (MBD). Both Syndromes are connected with problems during pregnancy and the delivery period of a child's life.
5. Treatment of children and adolescents, according to the authors, is the recovery of movements through beneficial forms of sport, such as karate, taekwondo, aikido, yoga, and through kinesiotherapy in geothermal waters.
6. Treatment of adults is to remove pain, regain motor activity and full function of the joints, preferably through stretching exercises in geothermal water.
7. Application of therapy using geothermal water, requires prior differential diagnosis – orthopedic, neurological, pediatric or internal. Only the correct diagnosis enables the implementation of the correct therapy.
8. There are already numerous Geothermal Rehabilitation Centres in Poland. The next ones will be created in a coordination program of “collective cooperation” of doctors, physiotherapists, local governments, Central Authorities and Scientific Teams of the Polish Geothermal Association.

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REFERENCES

1. TAMÁS BUDAY, PÉTER SZÜCS, MIKLÓS KOZÁK, ZOLTÁN PÜSPÖKI, RICHARD WILLIAM MCINTOSH, ERIKA BÓDI, BÉLA BÁLINT & KORNÉL BULÁTKÓ: Sustainability aspects of thermal water production in the region of Hajdúszoboszló-Debrecen, Hungary Environmental Earth Sciences volume 74, pages 7511–7521 (2015)
2. CHENG JC, TANG SP, CHEN TM, et al. The clinical presentation and outcome of treatment of congenital muscular torticollis in infants: a study of 1,086 cases. J Pediatr Surg 2000;35:1091-6.
3. GARNER J. Hungary's physicians believe in hot mineral water therapy. Can Med Assoc J. 1976 Apr 3;114(7):633-7. PMID: 1260606; PMCID: PMC1956862.

-
4. KARSKI TOMASZ, E. WARDA [1970] „Typowe zniekształcenia statyczne stóp kobiet noszących niefizjologiczne obuwie” *Polski Tygodnik Lekarski*, XXV, 17, 1970
 5. KARSKI Tomasz [1971] „Przydatność testu zgięcia podszwowego palców w ocenie niewydolności stóp. *Chirurgia Narządów Ruchu i Ortopedia Polska*, XXXVI, 6, 1971
 6. KARSKI Tomasz [1973] „Niektóre problemy stóp dziecięcych” *Pediatrica Polska*, XLVIII, 5, 609-612, 1973
 7. KARSKI TOMASZ, WOŚKO I. [1976]: „Problem der Ätiologie, Prophylaxe und Behandlung des muskulären Schiefhalses bei Kindern, Beiträge zur Orthopädie und Traumatologie”, 12, 701–706, 1976
 8. KARSKI Tomasz [1979] „Testy przydatne w ocenie zagrożeń stóp” „*Biomechanika i profilaktyka statycznych zniekształceń stóp*” Materiały z Sesji Naukowej, Lublin, 4-5, 12, 1979, PZWL, 113–116, 1980
 9. KARSKI TOMASZ [1980] „Testy przydatne w ocenie zagrożeń stóp” in „*Biomechanika i profilaktyka statycznych zniekształceń stóp*” Materials from the Scientific Session. Materiały z Sesji Naukowej, Lublin, 4–5, 12, 1979, PZWL, 113–116, 1980
 10. KARSKI Tomasz [1980]: „Testy przydatne w ocenie zagrożeń stóp” „*Biomechanika i profilaktyka statycznych zniekształceń stóp*”. Materials from the Scientific Session. Materiały z Sesji Naukowej, Lublin, 4–5, 12, 1979, PZWL, 113–116, 1980
 11. KARSKI Tomasz [1985] „Der Zehenflexionstest zur Erkennung Frühzeitiger Stadien von Funktionsstörungen und Deformitäten der Vorfusses” *Beitr. Orthop. Traumat.* 32/1985/, H. T., 305–307
 12. KARSKI TOMASZ [1988]: Wczesne leczenie dysplazji stawu biodrowego (Early treatment of dysplasia of hip joint). *Chirurgia Narządu Ruchu i Ortopedia Polska*, 1988, LIII, 2, stron 6
 13. KARSKI TOMASZ [1990] Wrodzone i nabyte wady stóp u dzieci, *Ortopedia, traumatologia i rehabilitacja narządów ruchu*, pod redakcją Prof. St. Piątkowskiego, PZWL, Warszawa 1990, 217–220
 14. KARSKI TOMASZ, KONERA W., MALICKI M. [1990] Statische und jatrogene Knieckplattfusdeformitäten bei Kinder. Erklerung der Erscheinungen und Möglichkeiten der Therapie *Szekesfeharvar*, 1990, October, 4–6, Dni Ortopedyczne Węgierskiego Towarzystwa Ortopedycznego.
 15. KARSKI TOAMSZ [1991]: Frühstbehandlung des muskulären Schlefhalses durch Torsionslagerung. *Orthopädische Praxis*, 11, 1991, 27, 691–695
 16. KARSKI TOMASZ, KARSKI J., SNELA S., OSTROWSKI J. [1995] Knickfussdeformitäten bei Kindern mit spastischer Verkürzung der Achillessehne. *Internationaler Gemeinschaftskongress*, 1995, 15 – 17 Juni, Berlin, Kurzfassungen – Block 6
 17. KARSKI J., KARSKI T., SNELA S., OSTROWSKI J. [1996] Fusschäden bei Kindern mit spastischer Verkürzung der Achillessehne. *Orthopädienschuhtechnik* 9/1996, *Zeitschrift für Prävention und Rehabilitation*, 24–26
 18. KARSKI TOMASZ, FRELEK-KARSKA M., PAPIERKOWSKI A., TACZAŁA J. [1996] Foot deformities at children with cerebral palsy *Annual Meeting of the Hungarian Orthopedic Association, Abstracts*, 20–21, Nyiregyhaza 20–22 June 1996
 19. KARSKI TOMASZ [1996]: Kontrakturen und Wachstumstörungen im Hüft- und Beckenbereich in der Ätiologie der sogenannten „idiopathischen Skoliosen” – biomechanische Überlegungen *Orthopädische Praxis* 32, 3 (1996) 155–160
 20. KARSKI TOMASZ, FRELEK-KARSKA MARIA, RIGO JANOS [2000]: Dobroczynne działanie ciepłych wód w leczeniu chorób narządu ruchu (Beneficial influence of geothermal waters in the therapy of orthopaedic diseases and malformations. *Geosynoptyka Geotermia* 2000 nr 1
 21. KARSKI TOMASZ, KARSKI JACEK, MADEJ JACEK, LATALSKI MICHAŁ: Persönliche Überlegungen zur Ätiologie der idiopathischen Skoliosen. Praktische Hinweisen zur Entdeckung beginnender Skoliosen. Möglichkeiten der Prophylaxe *Orthopädische Praxis* 02/2002, 38 Jahrgang, Seite 75–83

-
22. KARSKI TOMASZ, KARSKI JACEK, KAŁAKUCKI JAROSŁAW [2003]: Minimal incongruence of the hip joint of youth and adults treated and not-treated because of DDH in baby period. At the: Second Annual International Conference SICOT/SIROT 2003. Cairo, September 10–13, 2003. Abstr. [b. pag.] SFS8-H.
 23. KARSKI JACEK, KARSKI TOMASZ, KAŁAKUCKI JAROSŁAW, WÓJTOWICZ KRZYSZTOF [2003]: Minimal incongruence of the hip joint as the biomechanical cause of overloading of the femoral head. Explanation of reasons of the “painful hip” in youth and adults and development of coxarthrosis incipiens. *Magyar. Traumatol. Ortop.* 2003, Suppl. p. 80–81.
 24. KARSKI JACEK, KAŁAKUCKI JAROSŁAW, KARSKI TOMASZ, WÓJTOWICZ KRZYSZTOF [2005]: Incongruence of hip joint in treated and untreated persons with DDH in the baby period. Contribution to the knowledge of the very early stage of hip arthrosis (coxarthrosis incipiens). (Niezborność stawu biodrowego u osób leczonych w dzieciństwie z powodu wrodzonej dysplazji biodra i u osób nieleczonych. Przyczynę do wiedzy o wczesnych fazach koksartrozy (coxarthrosis incipiens)). *Annales UMCS Sect. D* 2005 vol. 60 nr 1, s. 32–39
 25. KARSKI TOMASZ, KAŁAKUCKI JAROSŁAW, KARSKI JACEK [2007]: Relationship of “syndrome of contractures” in newborns with the development of the so-called idiopathic scoliosis, *World J. Pediatr. / China*, 2007 vol. 3 nr 4, s. 254–259, bibliogr. 38
 26. KARSKI JACEK, DŁUGOSZ MARIUSZ, KAŁAKUCKI JAROSŁAW, KARSKI TOMASZ [2008]: “Science and opinion – knowledge and ignorance (Hippocrates) on examples in paediatric orthopaedics” – Blount disease, X-knee deformity, chronic pain in shank and foot by owners of small cars (P. 2). *Pohyb. Ustr. (Czech Republic)* 2008 R. 16 č. 3/4 suppl., s. 286–288.
 27. KARSKI JACEK, KARSKI TOMASZ [2014]: “Syndrome of contractures and deformities” according to Prof. Hans Mau as the primary cause of motoric deformities in children. Case studies including deformities of the hips, neck, shank and spine. *Archives of Physiotherapy and Global Researches*, year 2014, Volume 18, Number 2. Formerly “Zeszyty Naukowe”, Copyright 2014, Vincent Pol University In Lublin, Poland, pages 15–23
 28. KARSKI TOMASZ, KARSKI JACEK [2015] „Syndrome of Contractures and Deformities” according to Prof. Hans Mau as Primary Cause of the Hip, Neck, Shank and Spine Deformities in Babies, Youth and Adults. *American Research Journal of Medicine and Surgery*, Volume 1, Issue 2, 2015
 29. KARSKI JACEK, KARSKI TOMASZ, PYRC JAROSŁAW, KULKA MALGORZATA [2016]: Deformations of the Feet, Knees, Hips, Pelvis in Children and Adults with Minimal Brain Dysfunction. Causes. Treatment. Prophylaxis. *Czech Republic, Locomotor System*, vol. 23, 2016, No 2 / *Pohybové Ustrojí*, ročník 23, 2016, č. 2, Pages 20–31
 30. KARSKI JACEK, KARSKI TOMASZ [2016]: “Imperfect hips” As a Problem at an Older Age. Early and Late Prophylactic Management before Arthrosis, *Jacobs Journal of Physiotherapy and Exercises / USA / Texas*. 2016, (February, 2) 1: 015, Pages 7.
 31. KARSKI JACEK, KARSKI TOMASZ [2016]: Deformacje neuromięśniowe stóp, kolan, bioder, miednicy u dzieci. Wtórne zespoły bólowe u dorosłych. Przyczyny, zapobieganie i leczenie. Deformations of the feet, knees, hips, pelvis in children with minimal brain dysfunction. Causes, prophylaxis and treatment in children and adults. *Postępy Neurologii Praktycznej*, Wydawnictwo Czelej, 1/2016, Str. 3–11
 32. KARSKI TOMASZ, KARSKI JACEK [2016]: Bóle krzyża – problem neurologiczno – ortopedyczny. Objawy. Przyczyny. Leczenie. Back pain – neurology-orthopedic problems. Clinic, causes, therapy and prophylaxis. *Postępy Neurologii Praktycznej*, Wydawnictwo Czelej. 4/2016, Str. 9 – 16
 33. KARSKI JACEK, KARSKI TOMASZ, PYRC JAROSŁAW, KULKA MAŁGORZATA [2016]: Deformations of the feet, knees, hips, pelvis in children and adults with minimal brain dysfunction, Causes, Treatment, Prophylaxis, *Locomotor System* vol. 23, 2016, no. 2 / *Pohybové Ustrojí*, ročník 23, 2016, č. 2

-
34. KARSKI TOMASZ, KARSKI JACEK, KARSKA KLAUDIA, KARSKA KATARZYNA, MENET HONORATA [2017]: Patologie kyčle, kolena, hlezna a páteře v důsledku habituálního postojе "pohov" na pravé dolní končetině / Pathology of the hip, knee, shank and spine due to the habit of standing 'at ease' on the right leg. *Locomotor System* vol. 24, 2017, no. 2 / Pohybové Ústrojí, Czech Republic, ročník 24, 2017, č. 2
 35. Karski Tomasz, Karski Jacek, Pyrc Jaroslaw [2017]: Mozná příčina bolestivého Syndromu kloubu dolní končetiny – popis a kazuistiky, A possible cause of the "Pain Syndrome of Lower Extremity Joints". Description and case reports. *Locomotors System*, Czech Republic, Vol. 24, 2017, No 1, pages 10
 36. Karski Jacek, Tomasz Karski, Katarzyna Karska, Jaroslaw Pyrc [2017]: Ankle Joint Pathology of Car Drives and Passengers. Case Report. *American Research Journal of Medicine and Surgery*. www.arjonline.org 2017, Volume 2, Pages 1–12
 37. KARSKI TOMASZ, KARSKI JACEK [2017]: Ankle Joint, Knee, Hip Distortion Syndrome Connected with the Using of Small Cars. *Crimson Publishers, Ortho Res Online, Research Article*, 2017, Pages 1–4
 38. KARSKI TOMASZ [2017]: Physiotherapy – Correct, or Incorrect, Based on 'Wrong Principles of Treatment'. Example for the Spine, Hip, Knee, Shank and Feet. *Crimson Publishers [2017]: Ortho Res Online, Review Article*, 2017, Pages 1–5
 39. KARSKI TOMASZ, KARSKI JACEK, KARSKA KLAUDIA, KARSKA KATARZYNA, MENET HONORATA [2018]: Prophylaxis of Illnesses and Deformations of the Hips, Knees, Feet and Spine – An Important Aim of Physiotherapists, Pediatricians and General Doctors, *Physical Medicine and Rehabilitation – International*. Open. Austin Publishing Group. USA. *Phys Med Rehabil Int* 5(3): id 1147 (2018) – page 03
 40. KARSKI TOMASZ, KARSKI JACEK, KARSKA KLAUDIA, KARSKA KATARZYNA AND MENET HONORATA [2018]: Pediatric Prophylaxis Program of Motor System Deformations and Illnesses in Children. *Problems of the Spine, Hips, Knees and Feet, EC PAEDIATRICS, UK. Review Article. EC Paediatrics* 7.7 (2018), page 15.
 41. KARSKI TOMASZ, KARSKI JACEK, KARSKA KLAUDIA, KARSKA KATARZYNA and MENET HONORATA [2018]: Pediatric Prophylaxis Program of Motor System Deformations and Illnesses in Children. *Problems of the Spine, Hips, Knees and Feet, EC PAEDIATRICS, Review Article* 7.7 (2018)
 42. KARSKI TOMASZ, KARSKI JACEK, KARSKA KLAUDIA, KARSKA KATARZYNA and MENET HONORATA [2018]: Prophylactic Rules for Newborns, Babies, Children and Adults in problems of the Hip, Knee, Shank, Feet and Spine, *Online Journal CRIMSON PUBLISHERS, USA, Published: March 12, 2018*
 43. KARSKI TOMASZ, KARSKI JACEK, DOMAGAŁA MARIAN [2019]: "Syndrome of Contractures" According to Prof. Hans Mau; *Problems of the Shanks, Knees, Hips, Pelvis and Spine; Children, Adolescents, Adults, Diagnosis, Treatment. Surgical Science*. 2019, 10, 24–38. <http://www.scirp.org/journal/ss>. ISSN Online: 2157-9415. ISSN Print: 2157-9407. USA. 2019. DOI: 10.4236/ss.2019.101004 Jan. 24, 2019 24 *Surgical Science*. Pages 24–38
 44. KARSKI TOMASZ, KARSKI JACEK [2019]: Bole krzyża – związek z nawykami stania "na spocznij" na prawej kończynie donej. *Postępy Neurologii Praktycznej, Wydawnictwo Czelej*. 3/2019, Str. 7–14
 45. KARSKI JACEK, KARSKI TOMASZ, KARSKA KATARZYNA, MENET HONORATA, PYRC JAROSŁAW [2020]: Pathology of the Ankle Joint and Knee as a Result of Permanent Distortion Syndrome in Car Drivers and Passengers, *Clinical Surgery Journal, India-UK*, 2020, pages 1–5
 46. KARSKI TOMASZ, KARSKI JACEK, KARSKA KLAUDIA, PYRC JAROSŁAW [2020]: Knee Problems Connected with Incorrect Position of Sitting, *Journal of Orthopedic Science and Research, India & England, Res*. 2020, 1 (1): 1–13
 47. KARSKI JACEK, KARSKI TOMASZ, KARSKA KLAUDIA, PYRC JAROSŁAW [2021]: Rotation Distortion Syndrome of the Ankle Joint and Knee in Car Drivers and Passengers, *International Journal of Orthopedic Research, USA / Kansas*, 4 (1), 17–21

-
48. KARSKI TOMASZ, KARSKI JACEK, DUDIN MIKHAIL, PYRC JAROSŁAW [2021]: Perthes disease. Etiology. Symptoms. Physiotherapy. *International Journal of Orthopaedics Research, USA / Kansas*, 2021, Pages 1–7
 49. KARSKI TOMASZ, KARSKI JACEK [2021]: Toes Flexions Test to Recognize the Functional Status of the Foot: Examples of Pathology: Knowledge from 1971, *Journal of Orthopedic Science and Research, India & England, Res.* 2021; 2(2), 1–14
 50. KATALIN NAGY: Clinical and experimental tests carried out with medicinal water and medicinal caves containing radon University Doctoral Thesis 2008, University of Szeged Clinical Medicine Doctoral School
 51. KECSKÉS ISTVÁN, SÜLI-ZAKARI-TIBOR. "Debrecen, the city of spa (the thermal water based health tourism—the establishment and development of debrecen's health spa)." enhancing competitiveness of v4 historic cities to develop tourism: 154.
 52. MAU H: Zur Aetiopathogenese von Skoliose, Hüftdysplasie und Schiefhals im Säuglingsalter [Aetiopathogenesis of scoliosis, hip dysplasia and torticollis in infancy (author's transl)]. *Z Orthop Ihre Grenzgeb.* 1979 Oct;117(5):784–9. German. PMID: 549336.
 53. MENZ HB: [2016] Chronic foot pain in older people. *Maturitas Sep*; 91:110-4: /2016/j.maturitas.2016.06.011. Review.
 54. ROGERS GF, MULLIKEN JB. The significance of torticollis in deformational posterior plagiocephaly [abstract]. *Proceedings of the Tenth International Congress of the International Society of Craniofacial Surgery* 2003;61.
 55. SÜLYÖK J., KISS K. (2007): The Role of Culture in the Tourist Image of Hungary. – In.: Rátz T. – Sárdi Cs. (szerk.): *Intercultural Aspects of Tourism Development*, Kodolányi János University College, Székesfehérvár, pp. 165–172.
 56. VAJDA, R., VADAS, V. (1990): Magyarország gyógyidegenforgalma [Medical tourism in Hungary] (I-II. kötet), pp. 29., 33., 70.
 57. VAILLANT J, REVILLET P, SEVENIER AM, JUVIN R.: [2016]: Impact of fatigue on postural control in quiet standing in fibromyalgia. *Ann Phys Rehabil Med.* 2016 Sep; 59S:e124-e125. doi: 10.1016/j.rehab.2016.07.280.
 58. WATSON GH. Relation between side of plagiocephaly, dislocation of the hip, scoliosis, ba tears, and sternomas-toid tumours. *Arch Dis Child* 1971;46:203–10.
 59. www.ortopedia.karski.lublin.pl
 60. ZIMNY J. [2010]: *Odnawialne źródła energii w budownictwie niskoenergetycznym*, AGH, PGA, WNT, Kraków-Warszawa, 2010, ISBN 978-83-7490-378-3. Seria wydawnicza: Problemy ekoenergetyki i inżynierii środowiska. Tom 1.
 61. ZIMNY J., STRUŚ. M., LECH P., BIELIK S. [2014]: *Wytwarzanie energii elektrycznej z zasobów geotermicznych Polski*. Akademia Górniczo-Hutnicza – Wydział Inżynierii Mechanicznej i Robotyki, Politechnika Wrocławska – Wydział Mechaniczno-Energetyczny; Szkoła Ochrony i Inżynierii Środowiska AGH; Polska Geotermalna Asocjacja, 2014. s. 232. ISBN 978-83-63318-03-1.
 62. ZIMNY J., MICHALAK P., SZCZOTKA K. [2015]: Polish heat pump market between 2000 and 2013: European background, current state and development prospects. *Elsevier, Renewable and Sustainable Energy Reviews* 2015, Tom 48, str. 791–812.
 63. ZIMNY J., STRUŚ M., BIELIK S. [2015]: *Wybrane problemy energetyki zasobów odnawialnych: problematyka: „Czy Polska może być samowystarczalna energetycznie do 2030 roku z własnych zasobów odnawialnych – elektrownie jądrowe czy geotermalne?” – monografia naukowa*. AGH, WIMIR, PWR, WME, SOIIS AGH, PGA, Kraków – Wrocław 2015 r., ISBN: 978-83-63318-04-8, *Problemy Inżynierii Mechanicznej, Ekoenergetyki i Inżynierii Środowiska*, Tom 6.

-
64. ZIMNY J., STRUŚ M., KOWALSKI W., SZYMICZEK J., MICHALAK P., SZCZOTKA K. [2021]: Możliwości wykorzystania energii geotermalnej w Wielkopolsce - modernizacja systemu ciepłowniczego Nowego Tomyśla. Rynek Energii; ISSN 1425-5960. – 2021 nr 1 (152).

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