



Review

A review of the effectiveness of thermal infrared imaging in the diagnosis and monitoring of knee diseases



Mihaela Antonina Calin^{a,*}, Gilda Mologhianu^{b,1}, Roxana Savastru^{a,2}, Marian Romeo Calin^{c,3},
Consuela Monica Brailescu^{b,4}

^a National Institute of Research and Development for Optoelectronics INOE 2000, Magurele, Romania

^b National Institute of Rehabilitation, Physical Medicine and Balneoclimatology, Bucharest, Romania

^c "Horia Hulubei" National Institute of Physics and Nuclear Engineering IFIN-HH, Magurele, Romania

HIGHLIGHTS

- We reviewed the effectiveness of IR imaging in the diagnosis/monitoring of knee diseases.
- Good results were reported for the diagnosis of osteoarthritis, rheumatoid arthritis, ligaments and tendons problems.
- The best results were reported for monitoring of the patients after knee arthroplasty.
- IR imaging proved to be a sensitive diagnosis/monitoring method for these knee conditions.

ARTICLE INFO

Article history:

Received 19 September 2014

Available online 19 January 2015

Keywords:

Osteoarthritis

Rheumatoid arthritis

Ligaments

Tendons

Knee arthroplasty

ABSTRACT

Background: Thermal infrared imaging is used in many world-wide medical centers as an alternative or complementary diagnostic method for different disorders. The aim of this paper is to present the main clinical results reported in the literature concerning the effectiveness of thermal infrared imaging in the diagnosis and evaluation of knee diseases.

Methods: A search of four databases was conducted using specific keywords and phrases and explicit inclusion and exclusion criteria for the identification and analysis of the literature that presents data on the use of the thermal infrared imaging in the diagnosis and monitoring of knee diseases.

Results: Thermal infrared imaging proved to be a sensitive and reliable method for diagnosis, evaluation and monitoring of a number of knee conditions, including osteoarthritis, rheumatoid arthritis, ligaments and tendons problems. The best results were reported for monitoring of the patients after knee arthroplasty; the values of sensitivity and specificity of this method were of 90% and 89% respectively. Good results were also reported in the diagnosis of knee osteoarthritis with a sensitivity and specificity above 85%.

Conclusions: In conclusion, thermal infrared imaging proved to be effective in the diagnosis, evaluation and monitoring of some knee pathologies and could be used as a complementary method in association with classic medical imaging for the diagnosis, evaluation and monitoring of degenerative and inflammatory knee pathology, but further studies are needed to improve its performances.

© 2015 Elsevier B.V. All rights reserved.

* Corresponding author at: National Institute of Research and Development for Optoelectronics INOE 2000, 409 Atomistilor street, PO BOX MG5, Magurele, Ilfov 077125, Romania. Tel./fax: +40 (21) 4574522.

E-mail addresses: antoninacalin@yahoo.com, micalin@inoe.inoe.ro (M.A. Calin), mologilda@gmail.com (G. Mologhianu), rsavas@inoe.ro (R. Savastru), rcalin@nipne.ro (M.R. Calin), consuelabrailescu@yahoo.com (C.M. Brailescu).

¹ National Institute of Rehabilitation, Physical Medicine and Balneoclimatology, Bucharest, Romania, Clinique III, 11th Ion Mihalache Street, Bucharest 011171, Romania. Tel.: +40 (21) 3186458.

² National Institute of Research and Development for Optoelectronics INOE 2000, 409 Atomistilor street, PO BOX MG5, Magurele, Ilfov 077125, Romania. Tel./fax: +40 (21) 4574522.

³ "Horia Hulubei" National Institute for Physics and Nuclear Engineering, IFIN HH, 30 Reactorului Street, PO Box MG-6, R-077125 Magurele, Ilfov, Romania. Tel.: +40 (21) 4046199; fax: +40 (21) 4574440.

⁴ National Institute of Rehabilitation, Physical Medicine and Balneoclimatology, Bucharest, Romania, Clinique II, 2nd Sf. Dumitru Street, Bucharest 030077, Romania. Tel.: +40 (21) 3148084.

Contents

1. Introduction	20
2. Methods	21
3. Results	21
3.1. Diagnosis of knee osteoarthritis	21
3.2. Diagnosis of knee rheumatoid arthritis	21
3.3. Ligament injuries diagnosis and treatment	22
3.4. Detection of knee tendons pathologies	22
3.5. Evaluation after knee arthroplasty	22
4. Discussions	23
5. Conclusions	24
Conflict of interest	24
Acknowledgment	24
References	24

1. Introduction

There is a variety of knee diseases that cause pain and gait impairment for people of all ages. One of the most common diseases of the knee is osteoarthritis that represents a degradation of the articular cartilage and subchondral bone. As a result of the progressive degradation of the cartilage, it can occur: joint pain, swelling, tenderness, stiffness, and progressive decreasing of joint mobility, especially decline of the functional movement angles, with great impact on activities of daily living (ADLs) and on the quality of life of these patients. Cartilage injuries and disorders frequently affect the knee, because it is a weight-bearing joint and the degradation of the cartilage is usage- and load-dependent. There are described two main types of cartilage-related pathological conditions of the knee: chondromalacia patellae and meniscal injuries. Chondromalacia patellae occurs when the cartilage on the under-surface of the patella progressively softens and deteriorates; it is more common among young adults and athletic persons (as an overuse injury or the so-called “runner knee”), but it may occur in older people with knee arthritis. The meniscus can be easily injured. It can undergo partial or complete tear when the knee is twisted while bearing weight. Knee problems can be also caused by the ligament injuries (medial collateral, anterior and posterior cruciate ligament) consisting in stretching or tearing of the ligament as a result of a sudden action. The tendon injuries (tendinitis and ruptured tendons, Osgood–Schlatter disease, and iliotibial band syndrome) can also lead to different degrees of dysfunction of the knee. Other knee injuries such as osteochondritis dissecans and plica syndrome may also lead to a reduced range of motion of the knee.

The diagnosis of knee diseases initial involves a patient history and preliminary physical examination followed by different other tests including X-ray (radiography) and ultrasound [1], magnetic resonance imaging [2], radionuclide bone scan [3], computed tomography scan [4], arthroscopy [5] and biopsy [6] in order to identify the etiology of the knee problem. In addition to these methods, thermal infrared imaging (TII) has been used for several years as an alternative and complementary method for the diagnosis of knee pathologies [7–11].

After a complex investigation of the knee pathology (based on clinical evaluation and imaging results), the doctor can establish the certain etiologic diagnosis and the stage of the knee disease and can decide a strategic management for the treatment plan, based on realistic and reachable objectives. The main objectives for knee pathologies are: pain management, decreasing of local inflammation, improving the mobility and stability of the affected knee, gait restoration, better quality of life for the patient, regaining of the social and professional life. There are a lot of therapeutic methods for reaching these goals and the therapist will choose the

best method for each patient (individualized treatment plan), based on: the cause and stage of the knee disease, the presence and the intensity of local inflammation, the presence of blood or infection in the joint effusion, the presence of metallic implants in the knee area and co-morbidities of the patient (diabetes, high blood pressure, etc.) or medication (oral anticoagulants, etc.).

Therapy for knee pathology could consist of one or more of treatment possibilities, such as: (1) drug therapy (oral, local or intra-articular applications): anti-inflammatory products (non-steroidal or steroidal), analgesics (local or general), muscular relaxants, antibiotics, etc. (2) RICE concept (Rest–Ice–Compression–Elevation) as a simple method recommended for all inflamed knees, (3) medical helping devices such as knee orthosis (fixed, functional or soft models), crutches, sticks that must be prescribed by the therapist and the patient must be learned how to use them properly and how long, (4) physical therapy procedures based on electrotherapy (low/continuous/medium intensity currents), thermotherapy (ultrasound, short waves), low level laser therapy, etc. that must be prescribed by the physical and rehabilitation medicine (PRM) specialist and could be adapted from patient to patient and also, at the same patient during different phases of the disease or of the treatment and (5) medical exercises (kinetic therapy) prescribed by the PRM specialists and consisting in proper positioning of the affected knee, passive or active movements for ROM restoration, isometric/isotonic/resistive exercises for muscle strength and resistance, gait and coordination training; these medical exercises could be executed in bed, at home, in the gym hall or in the pool, under direct supervision of the therapist and are permanently adjusted to the actual clinical status of the patient, with progressively increasing in intensity, time and complexity of the program.

At the beginning and on the course of the treatment, the patient is permanently monitored by the therapist by periodically clinical examinations and by imaging objective evaluations, which ideally should be as less invasive, irradiant or painful as possible for the patient; that is why soft-tissue ultrasound is the best choices. TII can also play an important role by providing valuable information about the ongoing healing process and about the rehabilitation process of knee injuries that can help experts in making the right decisions concerning the patient treatment.

Thermal infrared imaging also known as infrared imaging or thermography is based on the physical phenomenon that all bodies, at a temperature above absolute zero, generate heat radiation in the infrared portion of the electromagnetic spectrum. The intensity and spectral distribution of emitted radiation depend on the body temperature. By detecting the infrared radiation emission from the body, it is possible to create a thermal map of temperature distribution by remote sensing. The thermal map (IR image) is usually created through the use of an infrared camera. The first generation of infrared cameras raised some technical

Download English Version:

<https://daneshyari.com/en/article/1784281>

Download Persian Version:

<https://daneshyari.com/article/1784281>

[Daneshyari.com](https://daneshyari.com)