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European Congress of Thermology 1974-2021-an Up-Dated Historical Perspective

How to use thermal imaging in selected surgical dental procedures?.

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European Congress of Thermology 1974-2021-an Up-Dated Historical Perspective

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SUMMARY

This is an updated historical perspective on the European Thermology Congresses in the period from 2009 to 2021. As with the previous review article, the schedules for lectures, the lists of delegates, abstract books, congress proceedings and photos of the congress participants were checked from the recent 5 conferences. Descriptive statistics were compiled regarding the origin of the participants, the number of participants and presentations per conference and the topics of the presentations.

In total 275 presentations have been given at the recent 5 European Congresses of Thermology. The median number of delegates at the congresses between 2009 and 2021 was 61, slightly higher than the median number of participants in the period 1990 to 2006 despite the pandemic-related low number of participants in the online congress 2021. Approximately 20% of all presentation originated from outside of Europe. There was a shift of topics predominant in the first 10 and the 5 recent congresses. In the period from 2009 to 2021, the topic of sport and/or exercise was at the top, followed by applications in veterinary medicine, vascular diseases, and standards/quality assurance. The Online Congress 2021 suffered from the COVID-19 pandemic but mastered this difficult challenge quite well in terms of scientific output.

Similar as the scientific literature on thermology, the history of the recent five European Congress of Thermology reflects the trends in thermographic research with a currently high interest in standard protocols for applications in sports and exercise science, animal thermography and vascular diseases.

KEY WORDS: European Congress of Thermology, period 2009 to 2021, Online Congress, European Association of Thermology (EAT), historical perspective

EUROPÄISCHER THERMOLOGIE-KONGRESS 1974-2021 - EINE AKTUALISIERTE HISTORISCHE PERSPEKTIVE

Dies ist eine aktualisierte historische Perspektive auf die Europäischen Kongresse für Thermologie im Zeitraum von 2009 bis 2021. Wie beim vorangegangenen Übersichtartikel wurden von aller Konferenzen die Zeitpläne für Vorträge, die Delegiertenlisten, Abstrakt-Bücher, Kongressbände und Fotos der Kongressteilnehmer gesichtet. Es wurden deskriptive Statistiken in Bezug auf die Herkunft der Teilnehmer, die Anzahl der Teilnehmer und Präsentationen pro Konferenz und die Themen der Präsentationen erstellt.

Insgesamt wurden 275 Vorträge auf den letzten 5 Europäischen Kongressen für Thermologie gehalten. Die mediane Anzahl der Delegierten lag bei den Kongressen zwischen 2009 und 2021 bei 61, etwas höher als der Medianwert von Teilnehmern im Zeitraum 1990 bis 2006 trotz der pandemiebedingten niedrigen Teilnehmerzahl am Online-Kongress 2021. Etwa 20% aller Präsentationen stammten von außerhalb Europas. Es gab eine Verschiebung von Themen, die in den ersten 10 und den jüngsten 5 Kongressen vorherrschten. Im Zeitraum 2009 bis 2021 lag das Thema Sport und/oder Bewegung an der Spitze, gefolgt von Anwendungen in der Veterinärmedizin, Gefäßerkrankungen und Normen/ Qualitätssicherung. Der Online-Kongress 2021 litt unter der COVID-19-Pandemie, meisterte diese schwierige Heraus- forderung aber in Bezug auf den wissenschaftlichen Ausstoß recht gut.

Ähnlich wie die wissenschaftliche Literatur zur Thermologie spiegelt die Geschichte der jüngsten fünf Europäischen Kongresse für Thermologie die Trends in der thermografischen Forschung mit einem derzeit hohen Interesse an Standardprotokollen für Anwendungen in der Sport- und Bewegungswissenschaft, Tierthermographie und Gefäß- erkrankungen wider.

SCHLÜSELWÖRTER: Europäischer Thermologie-Kongress, Zeitraum 2009 bis 2021, Online-Kongress, Europäische Assoziation für Thermologie (EAT), historische Perspektive

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Introduction

It is now 15 years ago that the historical development of the European Congress of Thermology was described [1]. 5 congresses later, it seems to be of interest to update this review on this main event of the European Association of Thermology (EAT) for both continuous professional education and forum for communication and exchanging ideas on recent progress in temperature related research in medicine and biology. The history of the EAT Teaching Courses, another important educational incentive of the EAT, was elaborated in 2017 [2]. Daniel Balageas published a survey on the Quantitative Infrared Thermography (QIRT) conferences, spanning the time from 1991to 2015. QIRT is not just a biennial conference. It is a fully independent, international, non-government, non-profit scientific organization

with the mission to advance knowledge and facilitate collaboration in the field of quantitative infrared thermography [3]. Co-operations between QIRT and EAT occurred regularly in the past through mutual participations in their conferences or organisation of medical thermography courses at QIRT-conferences. Francis Ring, Daniel Balageas, Boguslaw Wiecek, , Antonin Nowakowski, Anna Jung and recently Ricardo Vardasca engaged in this liaison.

Method

All available printed information from the recent 5 European Thermology Conferences were reviewed including presentations schedules, lists of delegates, books of abstracts, conference proceedings and photographs of congress participants. Abstracts were allocated to one topic only, in ambiguous cases the theme of the session, in which the paper was presented, caused the final assignment to a topic.

Descriptive statistics have been performed with respect to the origin of participants, number of participants and presentations per conference and topics of presentations. Results were compared with the findings in the first 10 conferences.

After presenting these results, a short description of each conference will follow with a focus on innovations in organisation of the conference and the steering team of the EAT combined with a glance on the social programme in each location.

Results

Data sources

The abstracts of all 5 conferences have been published in Thermology international. Full length articles from presentations at the 12th Congress appeared in a supplement of vol. 22 of the EAT journal Thermology international. List of delegates were available from the archive of the EAT, photographs were collected from the EAT webpage and the private archive of the author.

Participants

The average number of delegates at each conference was 75 varying between 44 and 105 participants. The low number in 2021 was probably because the meeting was completely virtual with online participation only.

Figure 1 shows the origin of the authors. In case that authors from more than one country collaborated, the origin is labelled as international cooperation and marked by a red arrow. Portugal and the United Kingdoms were both in the top rank each with 36 contributions, followed by international co-operations with 33 papers and Brazil with 20 presentations at the 3rd rank. Due to regular participation from Brazil, United States and Japan, contributions from outside of Europe encompassed 21% of all presentations in the recent five congresses.

Presentations

Figure 2 shows the number of presentations for the period 1974 to 2021. Comparison of the periods 1990 to 2006 and

Figure 1
Origin of presenters at the recent 5 European Congresses of Thermology

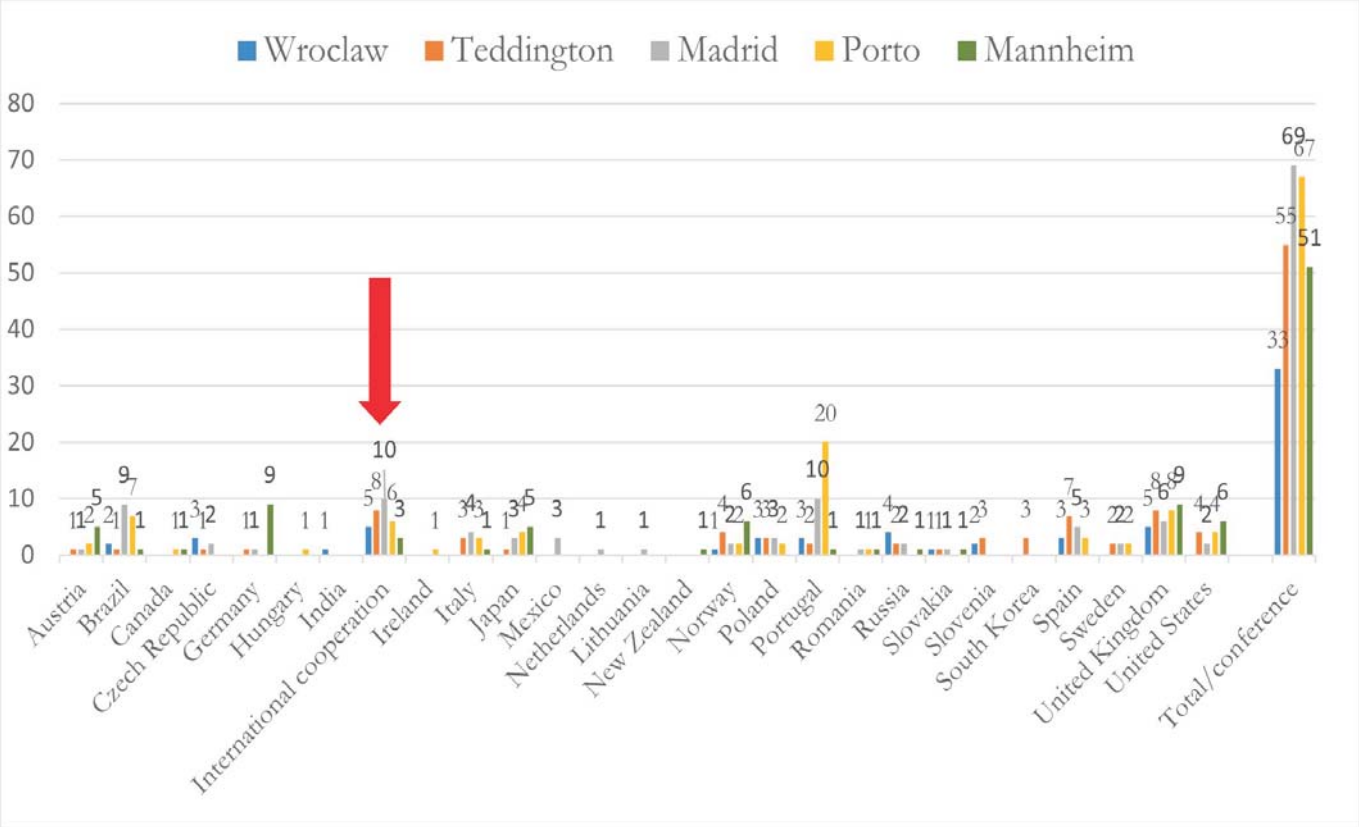


Figure 2
Number of presentations at the European Congress of Thermology 1974-2021

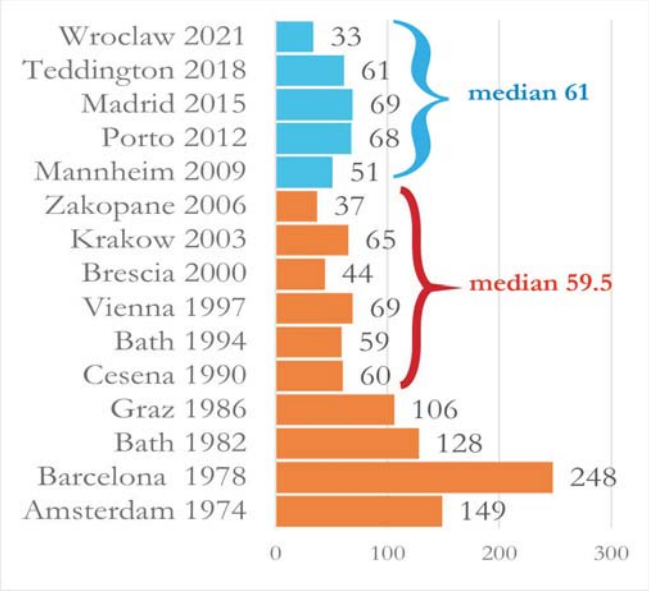


Figure 3
Proportions of invited lectures, oral presentations, and posters at the last 5 conferences 2009-2021

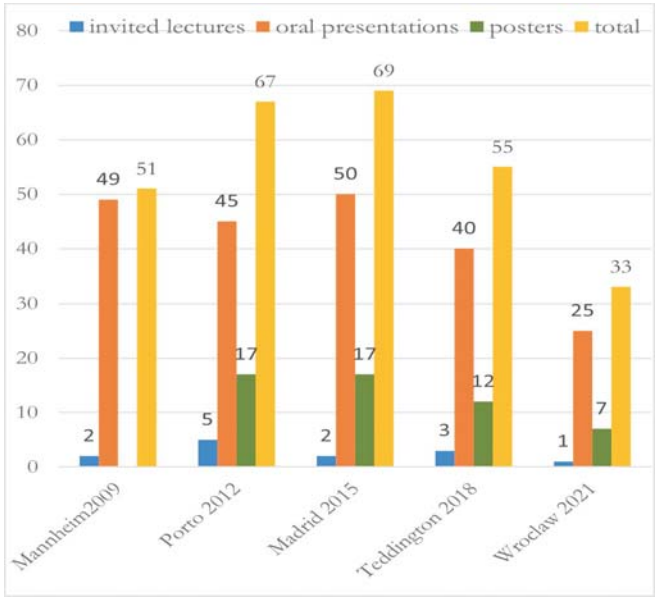
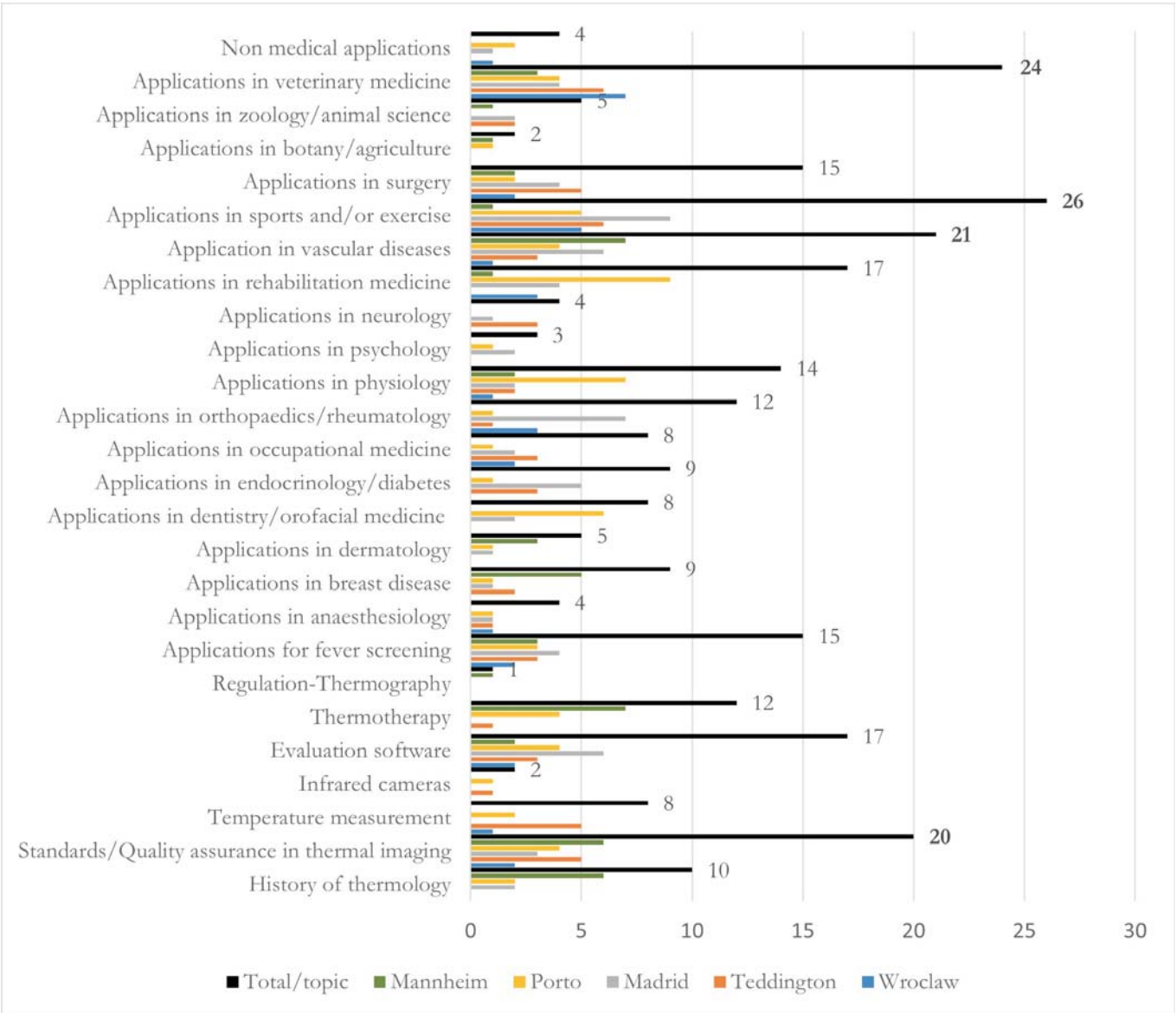


Figure 4
Topics of presentations at the EAT congresses between 2009 and 2021



2009 to 2018 obtained a stable number of presentations with median values of 59.5 and 61, respectively, despite the low number of attendances during the COVID-19 pandemic.

Figure 3 shows the proportions of invited lectures, oral presentations, and posters for the last 5 conferences. Similarly, a list of topics cumulated across the last 5 conferences is provided in figure 4. The topic with the highest number of presentations was applications in sports and/or exercise with 26 papers. Together with applications in rehabilitation medicine (17 papers), they represent 15.6% of the 276 presentations delivered in the period from 2009 to 2021. Applications in veterinary medicine was at the second rank with 24 papers, followed by thermal imaging in vascular medicine (21 papers) and standards/quality assurance with 20 papers.

11th Congress in Mannheim 2009

The Conference in Mannheim, Germany combined the 55th Annual Congress of the German Society of Thermography and Regulation Medicine and the 22nd Thermological Symposium of the Austrian Society of Thermology with the 11th European Congress of Medical Thermology and attracted 51 submissions from around the world. The sessions on standards for thermal imaging and thermo-therapy had the highest proportion of presentations. Invited lectures provided insights into applications of infrared thermal imaging in botany and in wild living elephants in South Africa. There was much discussion about a paper from Brazil proposing normalisation of temperatures extracted from thermal images.

Participants enjoyed a nice organ concert at the Church St. Sebastian listening amongst others to music composed by Bach, Händel, Haydn and Mendelssohn-Bartholdy.

At the General Assembly 2009 Prof James Mercer was elected as EAT president and Prof Jung moved to the position of vice-president. Prof Ammer continued in the combined roles as secretary/treasurer.

12th Congress in Porto 2012

Originally planned for Leiria in Portugal, the 12th Congress took place at the Faculty of Engineering of the University of Porto. It is the merit of Ricardo Vardasca that the EAT considered Portugal as an appropriate location of the EAT2012 conference. Ricardo got in touch with medical thermal imaging during his informatics study at the University of Glamorgan, where he received the degree Doctor of Philosophy (PhD) in 2010. The congress in Porto established some innovative ideas and procedures to the EAT congress. including 1.) promotion of poster presentations, 2.) a strict peer review of submissions and 3.) establishing 3 awards for presenters.

Ad 1.) Both the scientific and the organisational committee were interested in a higher rate of poster presentations since this may allow to limit the number of oral presentations and may lower the challenge of non-natural English speakers to present their work. Thus, all potential presenters of papers were offered to present their work either as oral lecture or as a poster.

Ad 2.) All submissions underwent a peer-review. Two referees blinded to the authorship independently assessed the submission using a 5-point scale (5 = outstanding, 4 = strong, 3=somewhat or mixed, 2=limited, 1=unclear or not at all) in the following categories: relevance, novelty, objective, methodology, results, conclusion, future implications. The mean value of the score in these categories was the result of assessment of 1 referee; the final score was built from the average score of both reviewers. The reviewer also made a recommendation to reject the submission or to accept it at top, medium or low priority. Proposals for revision aimed primary to the full-length paper that should be submitted until a deadline in early July. A collection of full-length papers became first available in September from the conference website hosted by the Faculty of Engineering of the University of Porto (https://paginas.fe.up.pt/~eat2012/).

Ad 3.) Very calm and privately, the EAT president-elect James Mercer and the EAT secretary-elect Kevin Howell prepared 3 awards for presenters at the conference: one for the best oral presentation, one for the best student oral presentation (Francis Ring prize) and another for the best poster presentation (Kurt Ammer prize). The name-patrons of these prizes, both involved in the organisation of the conference and evaluation of presentations were surprised and felt honoured when the prize winners received their awards.

The General Assembly 2012 accepted necessary amendments of their statutes related to the paragraphs §7 Rights and Duties of Members, §9 General Assembly, §11 The Board, §13 Tasks of the Members of the Board, Deletion of §14 Council of National Delegates and consecutive renumbering of the following 3 paragraphs. The new rules fit better to the evolved changes in member structure (more individual than society members), increased the number of board members from 3 to 6 by splitting the double function of secretary/treasurer and adding 2 board members without predefined tasks. This allowed to include recent initiatives in Portugal and Spain into the steering organ of the EAT. A new board was elected with Prof James Mercer as president, Anna Jung as vice-president, Dr Kevin Howell as secretary, Prof Kurt Ammer as treasurer, Dr Ricardo Vardasca and Prof Manuel Sillero-Quintana as general board members. Prof Adriana Nica from Romania and Aderito Seixas were appointed as auditors.

The scientific session provided a wide scope of issues ranging history of thermal imaging over standards to clinical application in human and veterinary medicine. Thermal imaging in rehabilitation medicine, in sports and exercise and in physiology had a high proportion of all presentations. 20 presentations came from Portuguese authors, and 10 from Spanish researchers, demonstrating the growing interest in thermology on the Iberian Peninsula.

Figure 5
Congress attentands in front of the Casa di Musica

The social programme was most enjoying including a visit in the famous House of Music in Porto (figure 5), a boat trip up the river Douro and a nice farewell dinner accompanied by an impressive demonstration of the imaging processing skills available in Porto managing to project the recorded thermal image from the upper back of a live performing violinist simultaneously on her back.

13th Congress in Madrid 2015

Manuel Sillero-Quintana, Spain´s enthusiastic pioneer of applying thermal imaging in sports science, hosted the 13th Congress at INEF-UPM, the Faculty of Physical Activity and Sports of the Polytechnical University of Madrid. Delegates from Europe and Oversea (USA, Mexico, Brazil, Japan) delivered 50 oral presentations and 17 posters. Prof Alexandr Urakov from Izhevsk, Russia, who participated since 2014 regularly in the Thermology Conferences in Zakopane, and the group around Eric Staffa and Vladan Bernard from Brno, Czech Republic, presented for the first time their research at an EAT Congress (figure 6).

Financially, the congress and the pre-conference Instructional Course with 25 instead of the expected 10 students were very successful. The income of 6700 Euro was kindly donated into the accounts of the EAT allowing the Association to continue with charitable activities.

The strict peer review of submissions was continued resulting in 28 recommendations for substantial revision, which were accepted from all but one author who retracted his two submissions. Finally, 51 out of 66 recommended revisions were performed.

Not unexpected, about 37% of all presentations were dedicated to the topics sports & exercise (9 papers), vascular diseases (6 papers), disorders of the locomotor system (7 papers) and rehabilitation (4 papers). This was also reflected by the two award winners, Ismael Fernandez- Cuevas for the best oral presentation (Francis Ring prize) and Jose Priego-Quesada for the best poster (Kurt Ammer prize). Several papers presented at the conference appeared as full-length articles in peer-reviewed journals such as Journal of Thermal Biology, Infrared Physics & Technology or Journal of Equine Veterinary Medicine.

Since Prof James Mercer decided to retire from the position of president, the EAT board had to be changed at the General Assembly 2015. Prof Mercer, who guided the EAT in the period 2009 to 2015 with good humour, infectious enthusiasm, and wise counsel, was proposed for Honorary membership, which was approve by the General assembly. Dr Kevin Howell was elected as president, Dr Ricardo Vardasca became secretary and Aderito Seixas got Board member.

The trip to Toledo with guided walking tour through the historic city and a visit in the impressive cathedral Santa Maria de la Asuncion was more than a welcomed compensation for the lack of time for sightseeing in Madrid. Per-

sonally, I was most impressed by the number of historic pipe organs located in the cathedral, the most famous of them are the Emperor`s organ, the General, the Echevarría and the Verdalonga.

Figure 6
2015 Conference participants in front of INEF-UPM (Physical Activity and Sports Faculty, Polytechnical University Madrid)

Figure 7
Congress delegates outside the NPL building

14th Congress in Teddington 2018

After 1982 and 1994 in Bath, the EAT congress returned to England and took place in July 2018 at the conference centre of the National Physical Laboratory in Teddington, London [15]. The congress attracted 84 delegates and the instructional course had 12 students. Twenty nations were represented at the Congress, with attendees from as far afield as the United States, Japan, South Korea, India and Brazil [16].

The peer review of the 58 submissions resulted in 12 paper rejections after the first round, and in only 3 of 55 accepted papers, amendments were not recommended. 35 of invited authors took the chance to improve their work [17].

Both the conference and the course were approved by the London Royal College of Physicians for CPD credits.

Graham Machin, Kevin Howell, John Allen and Rob Simpson organised and edited a focus collection on Thermal Imaging in Medicine for the journal Physiological Measurement [18]. Based on presentations from Italy, Norway, Spain, Portugal and the United Kingdom given at the 14th European Congress of Thermology the 10 articles selected show the diversity of contemporary clinical and clinically related applications for thermal imaging.

Arne Johan Norheim (University of Tromsø, Norway) was the winner of the Francis Ring award for the best Congress oral communication for his presentation on variability in hand rewarming rates after cold challenge in Norwegian army conscripts. The Kurt Ammer Prize, awarded for the best Congress poster, went to Erik Staffa (Masaryk University, Czech Republic) for his work utilising thermography for imaging ischaemia during bowel surgery [16].

The General Assembly 2018 confirmed the EAT board for another period. The proposal of awarding Prof Anna Jung with Honorary lifetime membership was unanimously approved by the General Assembly. The General Assembly was closed after an interesting discussion on the future access policy of the EAT journal "Thermology international [19].

Delegates enjoyed a relaxed evening at the EAT Gala Dinner, staged at The King's Head in Teddington, just a short walk from NP. Over dessert, Kevin Howell paid tribute to the efforts of Francis Ring and Peter Plassmann in developing the UK's leading centre for academic thermographic research at the University of South Wales. This unit was now due to close on the retirement of Francis. Kevin, Kurt Ammer, Ricardo Vardasca (University of Porto, Portugal), Rob Simpson (NPL, UK) and Ben Kluwe (University of South Wales, UK) had all received higher degrees arising from study at this centre, and all were present for this celebration.

Francis Ring, already in poor health condition due to a malign oesophagus tumour, enjoyed this meeting very much. A week before the conference, Francis and Kurt Ammer delivered the manuscript of the updated book "Human Body Temperature by Houdas & Ring"to the publisher. This project started in 2013, and the printed book "The Thermal Human Body" became available in May 2019. However, Francis has already produced a leaflet which he distributed at the conference. Graham Machin described the book as Francis´ heritage of knowledge and wisdom to guide researchers and practitioners to reliable thermal imaging of the human body.

15th Congress Online in Wroclaw 2021

Like most of the public and individual life since winter 2019/2020, also the 15th Congress have been dominated by the COVID-19 pandemic. The EAT had hoped to bring the XV Congress of the EAT to Wroclaw in Poland. A cooperation with the Faculty of Biology and Animal Science, Wroclaw University of Environmental and Life Sciences had been established and the conference was first announced in November 2019[21]. The first announcement contained already plenty touristic information, description of the conference facilities at the university, a list of hotels for accommodation and the draft of a social programme. However, forced by the pandemic the EAT Board had to make the difficult decision to switch to an online meeting late in 2020, which gave the Board member and the local organising committee under a year to make all the necessary arrangements.

The programming idea was to present the invited lecture by Prof Havenith and 11 papers as live recorded lectures, 6 on Thursday afternoon and 6 on Friday morning. Selection criterion for live presentation was a score in the top 12 ranks during the peer review of submissions. Authors of all other papers were asked to pre-record a video of their lectures which could be viewed on demand between 2nd to 3rd October. Posters had to be prepared for electronic presentations and were also accessible throughout September. Dr Maria Soroko organised an online platform providing facilities to run live presentations, pre-recorded presentations, and posters. Chats were used for communication with the auditorium. Chat messages were scanned by the session chairperson, and orally communicated to the lecturer.

44 delegates attended online, an in total there were 33 submissions presented in either poster, live presentation, or recorded video format. 7 papers were dedicated to animal welfare, equine physiology or veterinary applications. 5 papers were related to sports and exercise and 3 presentations each reported on thermal imaging in rehabilitation or disorders of the locomotor apparatus.

The poster prize was given to John Allen & B. Griffits (Coventry/Newcastle, United Kingdom) for their work "Explorations in skin temperature and objective skin colour measurements in Raynaud´s phenomenon: a pilot study". The Francis Ring prize for the best oral presentation was awarded to M. Canada et al. (Valencia, Spain) for "Infrared thermography to confirm the correct placement of the needle in the performance of lumbar sympathetic blocks for complex regional pain syndrome".

The instructional course was delivered via the same platform. 10 students attended the day of teaching on 1st September, and feedback on this first attempt to teach online was generally very positive. EAT president Kevin Howell thanked the faculty for their enthusiasm for teaching this course, and for their flexibility, bearing in mind that some faculty members were delivering the first online lectures of their teaching careers!

Discussion

The number of presentations at the European Congress of Thermology was rather stable over time. Comparing the period 1990 (5th Congress) to 2006 (10th Congress) with the period 2009(11th Congress) to 2021(15th Congress) revealed a median of 59.5 presentations for the 5th to the 10th Congress, and a slightly higher median of 61 papers for the 5 recent conferences. Exclusion of the 2021 congress results in an increase of the median to 64.5, indicating a trend to more presentations in the recent than the first period.

Organising the congress in a defined European country seems to stimulate the number of submissions from the nation where the congress took place. This became best obvious at the congress in Porto, where approximately 30% of all presentations originated from Portugal. Likewise, the high proportion of animal/veterinary thermography at the recent online congress might also by explained by the co-organising Wroclaw University of Environmental and Life Sciences.

There was a shift in the 4 predominant topics discussed at the European congresses. While in the first 10 congresses, breast, outcome measure, thermal physiology and liquid crystal thermography were top ranked, sports and/or exercise was in the top rank followed applications in veterinary medicine, vascular diseases and standards/quality assurance in the recent five conferences. This may be interpreted as a revived interest of veterinarians and animal scientists in infrared thermography. Veterinary thermography was amongst the promising applications reported at the famous Thermography Symposium in New York 1964[23]. Maria Soroko, chair of the Organising Committee of the 15th Congress, has contributed a lot to both standardisation and analysis of thermal images recorded in animals, particularly from horses [24-27].

The manifold of articles on thermal imaging in sports and/or exercise science published since 2010 [28-31] and an increased awareness of obligatory standards for recording and analysis of thermal images [32-34] may be reflected by the other top ranked topics of congress presentations. The increased use of thermography for perforator vessel detection [35-37] and quality assurance procedure in thermal evaluation of Raynaud´s phenomenon [38] may explain the position of vascular diseases among the predominant congress topics.

The Thermology Congresses 11 to 14 generated nice memories of the local scenery, culture and social interactions between delegates. This experience was missed during the Online Congress in 2021. Although the recorded lectures provided some information on the personal engagement of the presenters in their research project, receiving more details through personal communication was not possible. The local scenery of Wroclaw, the scientific and social life at the University of Environmental and Life Sciences remained obscured. But there might be a chance to make all this 2021 sadly missed experience in 3 years ahead if Wroclaw University agreed to host the 16th European Congress of Thermology in 2024.

In conclusion, a slight trend was detected towards an increased number of presentations in the 5 recent 5 EAT congresses. Procedures were established for conducting a rigorous peer review of submissions and to combining the European Congress with a preconference instructional course. These resulted in transparency of decisions and better scientific presentations. The Online Congress 2021 suffered from the COVID-19 pandemic but managed this difficult challenge quite well in terms of scientific output

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How to use thermal imaging in selected surgical dental procedures?

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SUMMARY

Infrared thermography (IRT), also called "thermovision" is a method widely used in medical and dental applications. This non-invasive and fast imaging method provides the doctor with additional diagnostic information, which may contribute to reducing postoperative complications and increasing the effectiveness and safety of treatment. In this article we present our own experience in the field of using thermography to monitor dental patients. We present, inter alia, the results of studies carried out on a group of patients after surgical extraction of impacted teeth. These studies showed temporary changes in skin temperature probably caused by inflammation, processes of tissue damage and repair (initial increase in average temperature, then a decrease in average temperature by almost 1.5°C between 1 and 4 days after treatment and a renewed increase in temperature between 5 and 7 days, when tissue is regenerating, and therefore increased blood supply and metabolism is present). We also presented the use of thermovision to assess inflammatory changes caused by the insertion of a dental implant. The average temperature of the skin area in close vicinity of the implant site, shows an upward trend the day after the procedure, which reflects the body's response to inflammation. The temperature drops significantly on the 12th day after the procedure, indicating that the implant procedure was correctly performed. In other studies, thermal imaging was used to assess root extraction. In all the presented examples, the use of IRT allowed for a better insight into the process of dental treatment of patients due to possibility to evaluate the skin temperature changes after treatment which may be associated with local metabolic processes and may confer complementary health state information.

KEY WORDS: thermography, extraction, impacted teeth, implant placement, soft tissue growth, removal of the tooth root

WIE VERWENDET MAN DIE WÄRMEBILDTECHNIK BEI AUSGEWÄHLTEN CHIRURGISCHEN ZAHNBEHANDLUNGEN?

Infrarot-Thermografie (IRT) , auch "Thermovision" genannt, ist eine in der Medizin und Zahnheilkunde weit verbreitete Methode. Diese nicht-invasive und schnelle bildgebende Methode liefert dem Arzt zusätzliche diagnostische Informationen, die dazu beitragen können, postoperative Komplikationen zu reduzieren und die Wirksamkeit und Sicherheit der Behandlung zu erhöhen. In diesem Artikel stellen wir unsere eigenen Erfahrungen auf dem Gebiet der Thermografie zur Überwachung von Zahnpatienten vor. Wir präsentieren unter anderem die Ergebnisse von Studien, die in einer Gruppe von Patienten nach chirurgischer Extraktion von Zähnen durchgeführt worden waren. Diese Studien zeigten vorübergehende Veränderungen der Hauttemperatur, die wahrscheinlich durch Entzündung, Gewebeschäden und -Reparaturen verursacht wurden (anfänglicher Anstieg der Durchschnittstemperatur, dann eine Abnahme der Durchschnittstemperatur um fast 1,5 ° C zwischen 1 und 4 Tagen nach der Behandlung und ein erneuter Temperaturanstieg zwischen 5 und 7 Tagen, wenn sich Gewebe regenerieren und daher eine erhöhte Blutversorgung und ein erhöhter Stoffwechsel vorhanden sind. Wir stellten auch den Einsatz von Thermovision zur Beurteilung entzündlicher Veränderungen vor, die durch das Einsetzen eines Zahnimplantats verursacht werden. Die durchschnittliche Temperatur des Hautbereichs in unmittelbarer Nähe der Implantat Stelle zeigt am Tag nach dem Eingriff einen Aufwärtstrend, der die Reaktion des Körpers auf Entzündung widerspiegelt. Die Temperatur sinkt am 12. Tag nach dem Eingriff deutlich ab, was darauf hinweist, dass das Implantationsverfahren korrekt durchgeführt wurde. In anderen Studien wurde die Wärmebildtechnik verwendet, um die Wurzelextraktion zu beurteilen. In allen vorgestellten Beispielen ermöglichte die Verwendung von IRT einen besseren Einblick in den Prozess der zahnärztlichen Behandlung von Patienten aufgrund der Möglichkeit, die Hauttemperaturänderungen nach der Behandlung zu bewerten, die mit lokalen Stoffwechselprozessen verbunden sein und ergänzende Informationen über den Gesundheitszustand verleihen können.

SCHLÜSSELWÖRTER: Thermographie, Extraktion, retinierter Zahn, Implantat-Setzung, Bindegewebswachstum, Zahmwurzelentfernung

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Introduction

Thermovision diagnostics was first used in clinical practice by the Canadian surgeon, Dr. Lawson in 1956. Over the years, this technique has developed through the evolution of measurement standards, the use of new generation detectors in thermal imaging cameras, with high resolution and thermal sensitivity, as well as the progress of computer technologies and digital image processing systems [1].

Thermal imaging differs significantly from other imaging methods such as X-ray, ultrasound, CT, and MRI. Structural imaging technologies do not provide the information offered by the infrared thermography (IRT), but give detailed anatomical information [2], contrary to the IRT, which shows the physiology of an observed region, not its anatomy, as the transfer of heat from deep tissues to the surface and from the skin to the environment follows the laws of physics, not anatomical structures.

As we know, temperature raised or decreased from normal is a traditional sign of the disease, and its measurement is often the first thing we do when we feel that something is wrong with our body. The superficial temperature of the inflamed area changes as inflammation is often manifested by redness, swelling, and fever, which can occur locally throughout the body [3]. The infrared imaging basically reflects the distribution of body surface temperature [3], most likely associated with the function of small, unmyelinated sympathetic C-type nerve fibers, as the sympathetic nervous system plays a key role in controlling local blood flow in the skin [4]. Thus, thermography is capable to detect and record infrared images that reflect the microcirculatory dynamics of the skin surface of human body, associated with the vascular, nervous and musculoskeletal systems, in addition to inflammatory processes [5, 6]. The IRT reveals the dynamics of microcirculation on the skin surface in real time, and therefore, it can contribute to making a diagnostic decision, despite the poor anatomical information.

In the assessment of thermal images, the obtained temperature values are analysed by assigning them to specific anatomical areas and finding the correlation between abnormal local temperatures as hot-spots or cold-spots and pathologies defined by methods other than thermography.

Moreover, the thermograms allow the visualization of temperature abnormalities i.e. hot and cold-spots. Criteria of positive findings must be defined for both the thermal image and the reference method. Common definitions of positive findings in thermal images include the difference of mean temperatures in corresponding measurement areas beyond a defined threshold or the temperature difference of an area to the surrounding area ("hot spots", "warm spots", "cold spots"). However, there are many circumstances that can result in the uncertainties of temperature readings from thermal images. They are associated with some inherent limitations related to the methodology of IRT data acquisition, such as, the camera distance to the subject and the physical factors as room temperature, humidity, or the air flow in the laboratory where IRT recording is conducted. It can affect performing thermal maps so the derived from thermal images data [7]. Also, when thermograms from different distances and/or field of view of the same subject are compared, the variable number of pixels within the ROI can lead to inaccurate data [7]. A checklist titled "Thermographic Imaging in Sports and Exercise Medicine (TISEM)" is a proposal to standardize the collecting and analysis of data. It is intended that the TISEM can also be applied to evaluate bias in thermographic studies and to guide practitioners in the use of this technique [7].

While there is no medical discipline that has established thermal imaging as the standard method of diagnosis and/or monitoring, it is used in almost every field of medicine, such as: oncology, neurology, dermatology, ulcer diagnostics, cardiology, surgery, sports medicine, gynecology, traumatology, immunology, ophthalmology, endocrinology, and dentistry [8-13]. There are many reasons why this technique has gained such widespread recognition in the medical community. First of all, IRT is a non-expensive and non-contact technique that enables observation of even a large area of the object. Thermography is also not invasive to the human body, as opposed to x-rays or ?-rays [3], and painless and therefore it is suitable for long-term and repeated use in the diagnosis of a patient. Finally, IRT is a real-time technique that allows you to monitor dynamic changes in temperature. All these aspects are undeniable advantages for which thermography has become an effective alternative diagnostic tool [14, 15].

In dentistry it is used, among others to analyse the condition of periodontium or temporomandibular joints (Temporomandibular disorders, TMD) [4, 16, 17]. In maxillofacial surgery, it is applied to diagnose odontogenic foci of infection, cancerous diseases of the oral cavity, diseases of the maxillary sinuses and salivary glands [18] or to evaluate postoperative inflammation after tooth extraction [19]. IRT is also used to evaluate dental socket healing after photo-biomodulation therapy (PBMT) [19] or a PDT (Photodynamic Therapy) [20].

Thermography is also used to assess the state of thermally damaged dental pulp [21] after using the method for debonding of orthodontic brackets, i.e. Electro Thermal Debonding (ETD). Thermal imaging analysis showed that the temperature of the pulp increased from 16.8°C to 45.6°C during the ETD, posing a serious threat to pulp viability. Due to these measurements, it was discovered that the safe application of this method requires periodic cooling of the teeth and simultaneous thermal imaging. The use of ultra-fast pneumatic drives carries the same risk, and there is also a necessity to monitor the procedure with thermovision [22]. A similar situation of heat production has been observed during root canal obturation [23, 24, 25]. Different cooling systems are also used when placing dental implants in the craniofacial bones. Excessive temperature fluctuations during the preparation of the implanta-

tion site may affect the osseointegration process of the bone with the implant. Thus, also in this case, the thermovision becomes useful for the non-invasive observation of the bone drilling process [26], as well as for the assessment of heat generation and drill wear during implant site preparation [27, 28, 29].

The infrared skin temperature measurement is an objective method that can be applied as a complementary diagnostic tool when the infraorbital [30] or inferior alveolar nerve is injured [31, 32]. The thermal imaging used in patients with a defect of the inferior alveolar nerve showed ΔT +0.5°C values on the affected side, while in those without the deficit it revealed a symmetrical thermal value of ΔT +0.1°C, contributing to the discovery that these changes result from blockage of neural narrowing of blood vessels [15, 32].

Infrared thermography enables distinguishing between patients undergoing active orthodontic treatment and patients with TMD, which was found by comparing the ΔT values between the groups of active orthodontic patients, patients with TMD and the asymptomatic control group TMJ, where the mean ΔT values of the temporomandibular joint (TMJ) area were respectively +0.2°C, +0.4°C and +0.1°C [22]. Canavan et al. studied a group of temporomandibular joint disorder (TMD) subjects and found that ΔT values are correlated with the level of pain in the subjects [14].

Thermography has also found application in the assessment of pain in patients undergoing extraction [33] or chronic orofacial pain. Thus, a new system using thermograms has been introduced for subjects with chronic oro-facial pain for classifying ΔT measurements in the facial area [15]. Thermograms were classified as normal, hot and cold, when the selected ΔT values of the anatomical area (right and left temperature difference) were 0-0.25°C, more than 0.35°C and less than 0.35°C, respectively. Hot thermograms can support a clinical diagnosis of sympathetic sustained pain, peripheral nerve pain, temporomandibular arthropathy (TMJ), or maxillary sinusitis, while cold, can prove peripheral nerve pain, or sympathetic non-sympathetic pain. Normal thermograms included subjects with a clinical diagnosis of cracked tooth syndrome, trigeminal neuralgia, pre-trigeminal neuralgia, or psychogenic facial pain [14].

Thermovision also helps detect labial herpes in the prodromal phase [15, 34], assess cranio-mandibular disorders, reveal carotid occlusal disease, quantify the results of post-surgical inflammation, or the effects of painkillers and anti-inflammatory drugs, and is useful in the diagnosis of myofascial symptoms [22]. Thermovision is useful also in assessing and distinguishing between vital and dead teeth. Teeth subjected to non-surgical endodontic treatment turned out to be colder than vital teeth and teeth suspected of pulp necrosis [35].

Undoubtedly, the publications of ISO and AST standards have contributed to the fact that thermography has become credible as one of the medical and diagnostic procedures [1]. Proper patient preparation and standardization play a key role in the reliability of this method. The efforts of the scientific community, professionally dealing with medical thermography, related to the spread of knowledge in the field of thermographic research methodology are also important. Therefore, this review highlights some of the latest advances in infrared thermography and the possibility of using it as a tool for monitoring dental patients. In this paper, we present our own experiences in this area. We hope, that thanks to reviews similar to ours, which systematise the applications and methodology in this field, thermography in the near future will certainly become a unique research tool in dentistry.

The aim of our article is to show applying of thermography in dentistry, analyzing and synthesizing their findings taking into account our results and providing studies. That is why this article is focused on own experiences in use of thermal imaging as a diagnostic as well as quantity evaluation tool in selected dental procedures and its correlation with other standard used imaging methods i.e. roentgen (RTG) or cone beam computed tomography (CBCT).

Method and Material

The measurements were performed according to the practical guidelines described in "Guidelines For Dental-Oral And Systemic Health Infrared Thermography" and proposed by the American Academy of Thermology (AAT) [2]. The examinations were completed at a health and dental clinic, ComfortDent, in Katowice, in a room that meets standards for thermal diagnostic in medicine where the temperature and the moisture content in the test room were monitored and maintained at a constant level of 19 ± 1°C and 43 ± 5%, respectively.

Placing high-temperature infrared sources near the object was avoided, as well as the action of wind (direct air conditioning blowing). Similar standards of conduct were observed in other similar types of research [3, 19].

Thermal imaging was performed with a thermal camera, FLIR Systems T640, equipped with a microbolometric detector being an FPA matrix detector with sensitivity of 0.03K. The camera was installed on a tripod placed 0.9 ± 0.1 m from a patient. Measurements with the use of a tripod and keeping a fixed distance from the patient are also recommended in studies by other authors [18, 20]. In described studies imaging covered the sagittal plane of the face on the side of the procedure, as well as the control (healthy) side what in presented in the scheme in Figure1.

Each patient was informed about the contraindications to participate in the study, i.e., the use of (pharmacological) stimulants, painkillers and anti-inflammatory drugs, exercise or sunbathing within 24 hours before the study. As in other studies [3, 19], patients were asked to refrain from smoking for at least 4 hours prior to the study, not to take medication and stay in a temperature-controlled room for 15 minutes prior to imaging, and remain seated during the test. Similarly, the patient's medical history, oral cavity as-

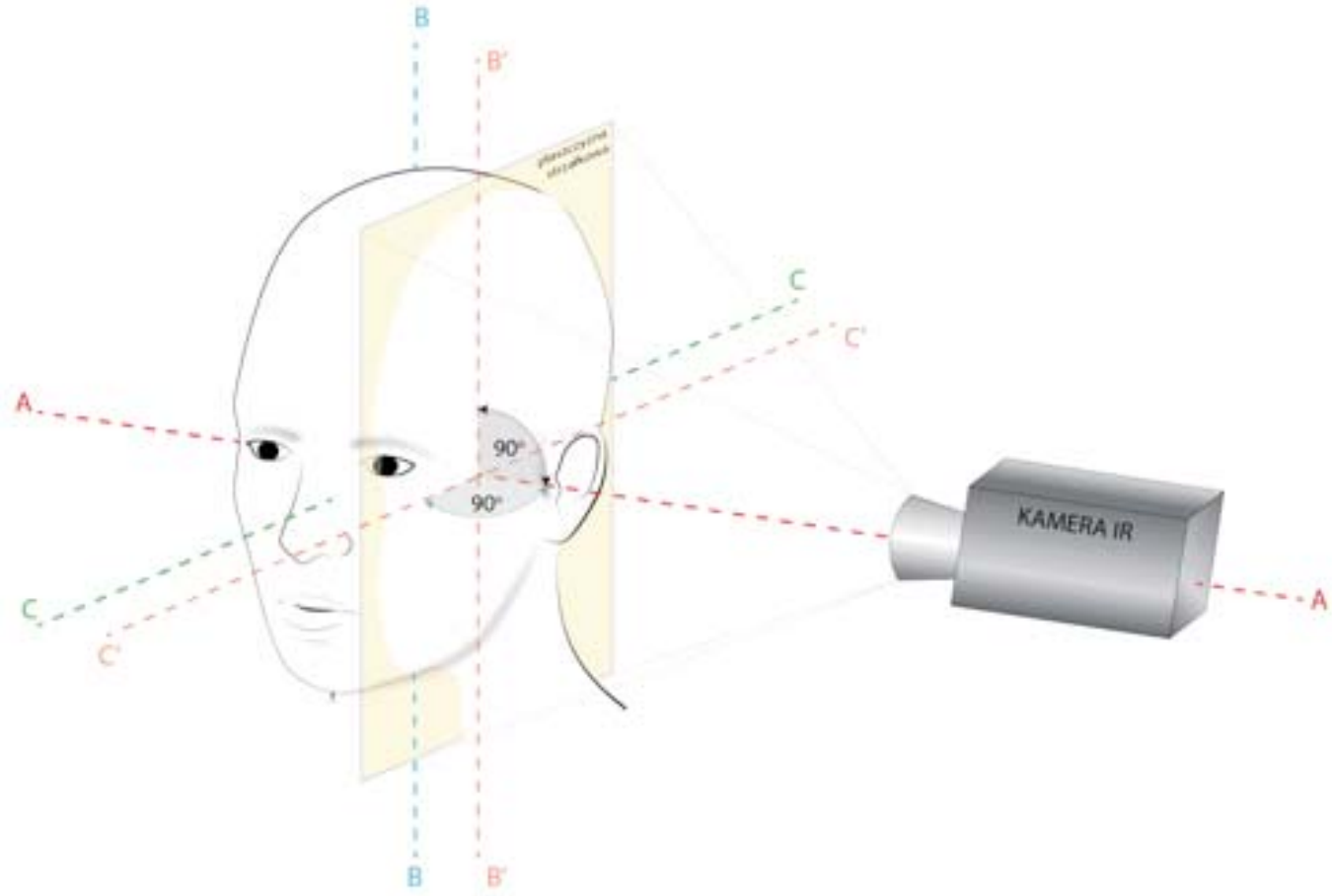

Figure. 1
Scheme of thermal imaging in dental patients
The camera has been placed on the tripod and B '-B' and C '-C' axes define the imaging plane, parallel to the sagittal plane (B-B and C-C). The A-A axis determines the perpendicular orientation of the camera to the sagittal plane.
The camera-patient distance was 0.50 ± 0.05 m.

sessment and periodontal examination were performed as standard procedures. In this study, we also took into account BMI values, selecting only people with normal BMI values for testing.

The thermograms were analyzed in the ThermaCAM Researcher Pro 2.10 software, where selected areas affected by the disease were marked, i.e., the buccal area AR01, and the third molar area, AR02. The scheme is presented in figure 1. The temperature values obtained were analyzed with Microsoft Excel 2018 and Statistica Soft 12 applications.

The mean temperature for chosen Regions of Interest (ROI) was always calculated as an average of all pixels in marked area. The relationship between mean temperature values between measurements was analysed with a non-parametric equivalent of the Student's t-test for related samples, i.e., the Wilcoxon's test. To determine statistically significant differences, a p parameter value lower than or equal to 0.05 was assumed.

The average temperature for a selected Regions of Interest can also be determined according to a procedure slightly different from ours [18], but to our knowledge, the method presented by us is also accurate.

Results and discussion

Presented and discussed results describe the use of thermal imaging in chosen surgical dental procedures that has been performed by authors in comparison to literature.

In study titled "The applications of infrared thermography in surgical removal of retained teeth effects assessment" participated 27 patients, aged 27 to 40. The patients were referred for a surgical removal of the impacted third molar. The thermal imaging was done for each patient before and immediately after extraction of the impacted third molar as well as 1, 4 and 7 days after the procedure [36, 37].

A similar method of proceeding with the thermographic observation of the patient every few days and the changes occurring in the periodontium and oral cavity is presented in other studies carried out according to the AAT recommendations [18, 19]. Additionally, it is known that thermal imaging may also be influenced by the type of tissue being imaged, and in particular, the presence of adipose tissue as an effective insulator may result in lower temperature readings [20]. Therefore, following generally accepted standards, we also selected people with correct BMI values for the study.

The panoramic and thermal images performed 1 and 7 days after the procedure for representative patient are presented in figure 2.

Conducted studies showed changes of skin temperature in time due to inflammatory state correlated with third molar condition and performed surgical procedures. It was shown

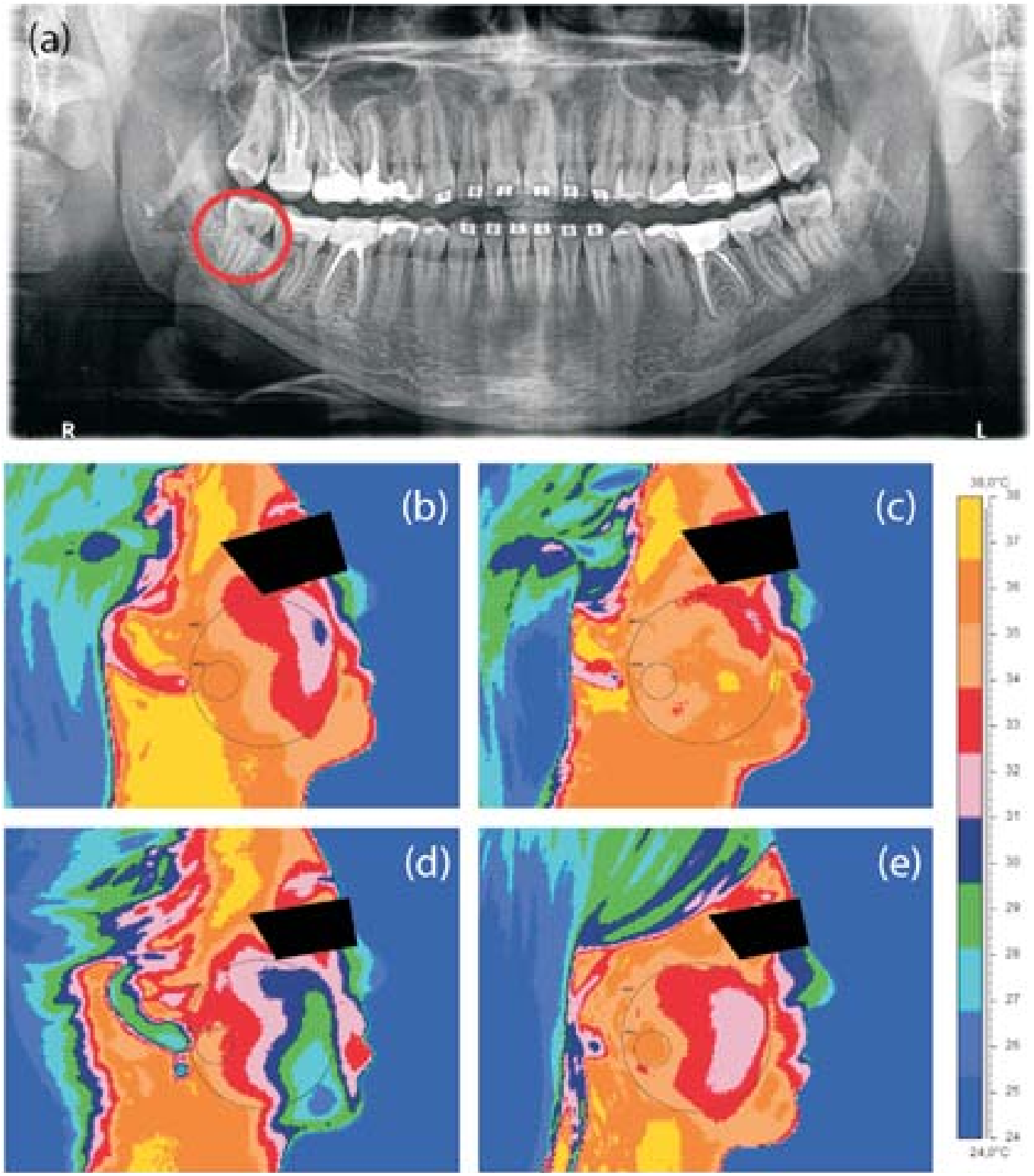

Figure 2
Panoramic image (a) and thermal images, where: (b) - before, (c) - after, (d) - 1st day after, (e) - 7th day after surgical extraction of the impacted lower, right third molar for a representative patient from group 1

Source: Own research obtained by analyzing IRT images for patients examined at the ComfortDent Health and Stomatology Clinic in Katowice, using the FLIR Systems E60 and T640 thermal imaging camera, equipped with a microbolometric detector being a matrix FPA detector with a sensitivity of 0.05 and 0.03 K. Thermograms were analyzed in the Therma-CAM Researcher Pro 2.10 application.

and can be easily seen in the figure 2 that before the procedure, the cheek area localized above the third molar had higher mean temperature than the whole buccal area. It should be noted that retained teeth are frequently associated with inflammatory states which may lead to increase in temperature not only of gingiva but especially in the cheek area what can be easily detected by infrared thermography. It was proved that after the procedure, mean temperature difference between buccal and area characterized the third molar decreases what suggested the healing process after proper performed surgical procedures. Moreover, in the period between 1 to 4 days after the procedure, an increase in the temperature values was seen in the tooth area, opposite to the buccal region. This may be explained by the initiation of tissue repair processes and an increase in the blood microcirculation, thus metabolism. It should also be emphasized that immediately after tooth extraction, the alveolus is filled with blood and a thrombus is formed, and this may alsocontribute to an increase in the temperature in this area [36].

However, considering only the temperature in the third molar region it was showed that the temperature drops between day 1 and day 4. Obtained mean temperature drop was nearly 1.5°C and seemed to relate to improved microcirculation due to repair processes taking place in the tissue. Such situation was observed in all patients, so the conclusion was that the procedure has been performed properly and no additional inflammatory states occurred.

The dynamics of occurring processes was reflected in the thermal map of the body surface, so it was possible to evaluate them and the statistically significant change in the temperature was obtained after four days after the procedure what has been described as a gradual recovery of the body. It was also substantiated with the fact that between 4th and 5th day the proliferation of epithelial cells in soft tissues begins. Prior to that process, the phagocytosis is initiated and the neoangiogenesis starts so the network of blood vessels grows. Then bone resorption occurs as a result of osteoclast activity, and a new bone is created [38]. That is why the significant decrease of tooth area temperature between 1st and 4th day after surgical intervention may be related to the end of phagocytosis process. In terms of homoeostasis restoration, the fact of obtaining statistically significant differences for comparison of the skin temperature at day 7 after the procedure versus the temperature before and after the procedure appears to be very important from the point of thermal evaluation of the performed procedure effects. The presence of vascular structures and fibroblasts may increase the local metabolism and, consequently lead to a temperature increase between 4th and 7th day after the procedure. Differences demonstrated in this case show that the healing process progresses in time, and the measurements performed with a thermal camera indirectly reflect changes in tissue metabolism [37]. It can be also seen that temperature increased after the extraction. This, may be explained by surgery in this area, as well as filling of the alveolus with blood and the formation of a thrombus, which contains numerous substances responsible for the cleaning of the post-extraction wound [37, 39,40,41]. Important consideration is that the studies, due to the problem with accessing third molars, were performed on the facial skin surface, and reflected dynamics in skin temperature changes. However, it was statistically proved that it indicated the inflammation intensity for impacted teeth indirectly and a scope of repair mechanisms occurring in the deep tissue [38,39].

According to a study by Christensen et al., thermography appears to be useful for the quantification of inflammation between the intervention and control side following surgical removal of mandibular third molars. In these studies, the temperature of the operated side (mean: 32.39 °C, range: 28.9-35.3 °C) was higher than that of the control side (mean: 32.06 °C, range: 28.5-35.0 °C) 2 days after surgery [18]. Similar effects were observed in the work of Batinjan et al., in which patients were subjected to laser irradiation (aPDT) after removal of the impacted mandibular third molar [20]. Before the surgical intervention, there was no difference in temperature between the groups (placebo and subjects vs. PDT). On the third day after surgery, the temperature increased in both groups, and additionally it was significantly higher in the placebo group than in the aPDT group, which was explained by the occurrence of greater wound swelling in the placebo group than in the aPDT group [20]. Also in the work of Carvalho et al. the usefulness of thermal imaging has been demonstrated in the evaluation of alveolar healing after tooth extraction (18 and 28) and after the use of photobiomodulation therapy. In the first two postoperative sessions, the temperature was higher on the treated side, and after the third laser application, the left side became hyporadiant. In a later session, the treated side became excessively radiant compared to the control side [19]. Thus, the result obtained by us, namely the initial (before the procedure) higher average temperature of the cheek area located above the third molar (than the entire buccal area) and the subsequent lower average temperature difference between the cheek and the area characterized by the third molar (after the procedure), is a similar to the observations of other researchers.

In another own study titled "*The applications of thermal imaging in dentistry - pilot study*", the thermovision was used in the assessment of the inflammatory changes induced by the dental implant [42]. The imaging was done on six patients who underwent implantation before and after, and in 2nd and 12th day post-treatment in the cheek on the side of the performed procedure and on the healthy cheek as the control side.

Temperature parameters obtained from thermal images suggest that inflammation appeared directly after the procedure what was expected due to actions performed during the surgery. The temperature measured in 2nd day after intervention may suggest that inflammation is maintained till 12th day, when the healing processes should finish. Computer Tomography image and thermal images of a representative patient subjected to an insertion of an implant

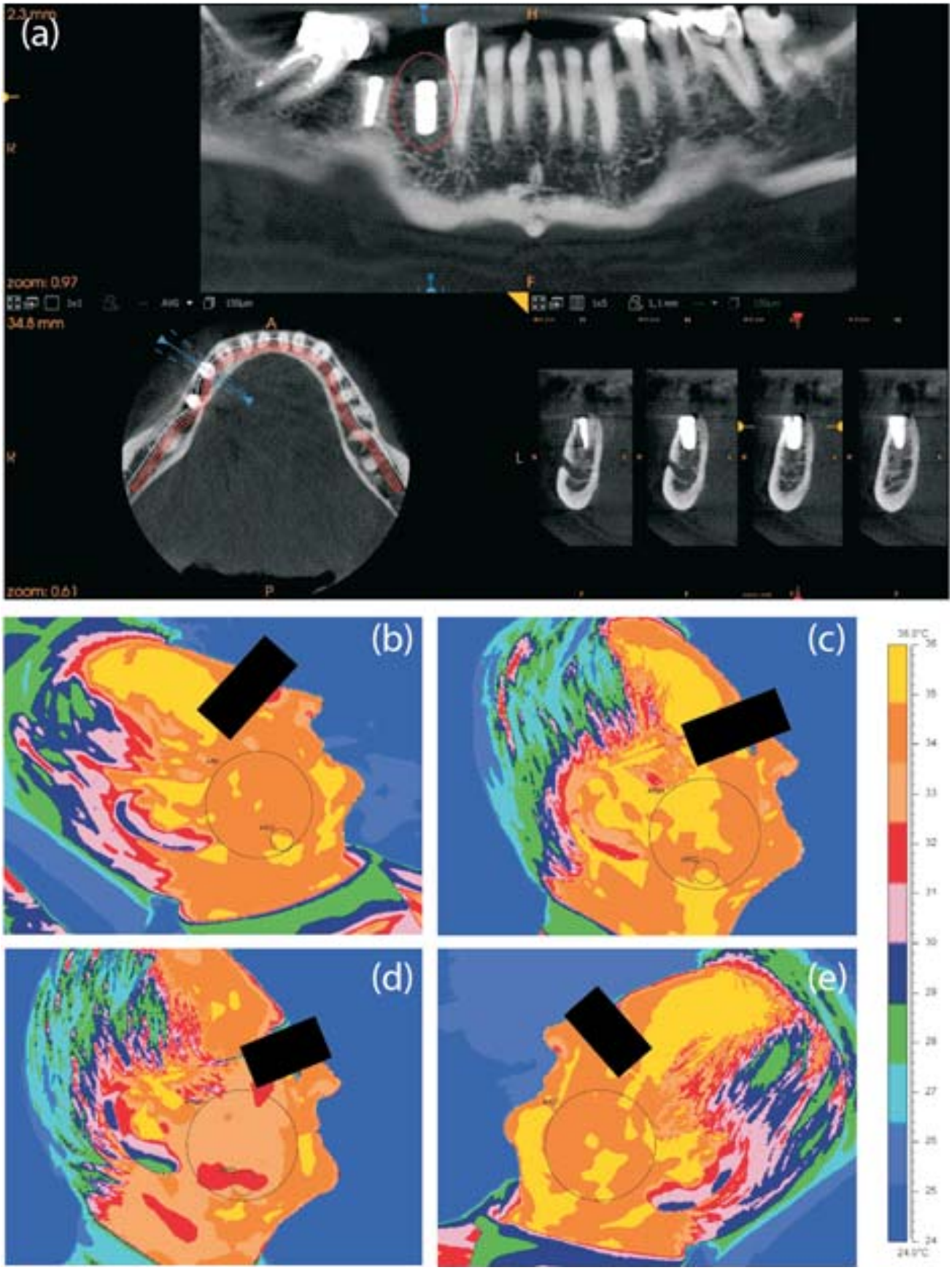

Figure 3
CT and thermal images of a representative patient subjected to insertion an implant screw in the area of the lower right first molar (46) together with the area of implant, where:
(a) - CT picture,
(b) - before implant insertion,
(c) - after implant insertion, (d) - 12th day after,
(e) - control side before implant insertion.

screw around the lower right first molar, 46, together with the area of implant, in selected periods of study is presented in figure 3[42].

It can be easily noticed from figure 3 that before the procedure, the cheek on the side of the surgery and the control side are characterized by similar temperature. Situation changes after the implant insertion as the temperature significantly raises. Temperature map of the right cheek on the intervention side reveals the range of the intense metabolism due to the insertion of the implant screw, drilling and other actions made.

Temperature significantly decreases in 12th day after treatment what suggests that no additional inflammatory states occurred and the implant insertion was performed properly. Similar temperature response has been obtained in rest of studied volunteers.

The average temperature of the region of interest correlates with the area of insertion of the implant on the day following the procedure and shows an upward trend, which seems to reflect the body's response to inflammation. Indeed, the increased local blood circulation is activated supporting chemotaxis of leukocytes on the site of damage, and then, cytokines inducing inflammatory responses are produced [39, 43, 44]. This entails a local increase in tissue metabolism, which may be reflected in thermal imaging of the treated regions.

Obtained in time decreasing of temperature amplitude changes on the surgical intervention side so the decreasing of temperature differences between measured regions of interest on both cheeks may suggest the diagnostic parameter as a attenuation coefficient that can describes the dynamics of healing process.

Summarizing the described results, it should be highlighted that the obtained dynamics of changes in the calculated thermal parameters correlates with the literature data on the formation and regeneration of tissues affected by inflammation so it confirms the usefulness of thermal imaging in various dental interventions.

In other unpublished own studies contained results of surgical dental procedures, thermal imaging was used in the assessment of the removal of root of the tooth.

Figure 4 presents the thermal images of the patient taken before and after the removal of the root of the tooth 24. It was a subsequent suggestion of thermal imaging use in dental procedures.

The thermogram on the left sid , taken before the procedure, shows the area of the increased temperature, which coincides with the location of the intervention. The elevated temperature appears to be the indication of the onset of inflammation due to a foreign body left in the gum tissue. After the surgery, the temperature of the cheek of the operated side rised slightly (obtained average temperature raise of 0.4°C). It is worth noting that the temperature of the treatment area decreased by more than 1°C, which is caused by the anaesthesia with vasoconstrictor, which reduced circulation, Such thermal map brings information about the depth of anaesthesia what also may be helpful for dentists.

It seems that the surgical procedures first associated with an increase of cheek-temperature, but if the wound is healing properly, after a few days the temperature on the side of the performed surgery decreases, with a tendency of equalizing it with the non-operated side. Similar results were obtained by other authors [18,19,20], which support the utility of thermal imaging in dental surgery as completely non-contact evaluation method.

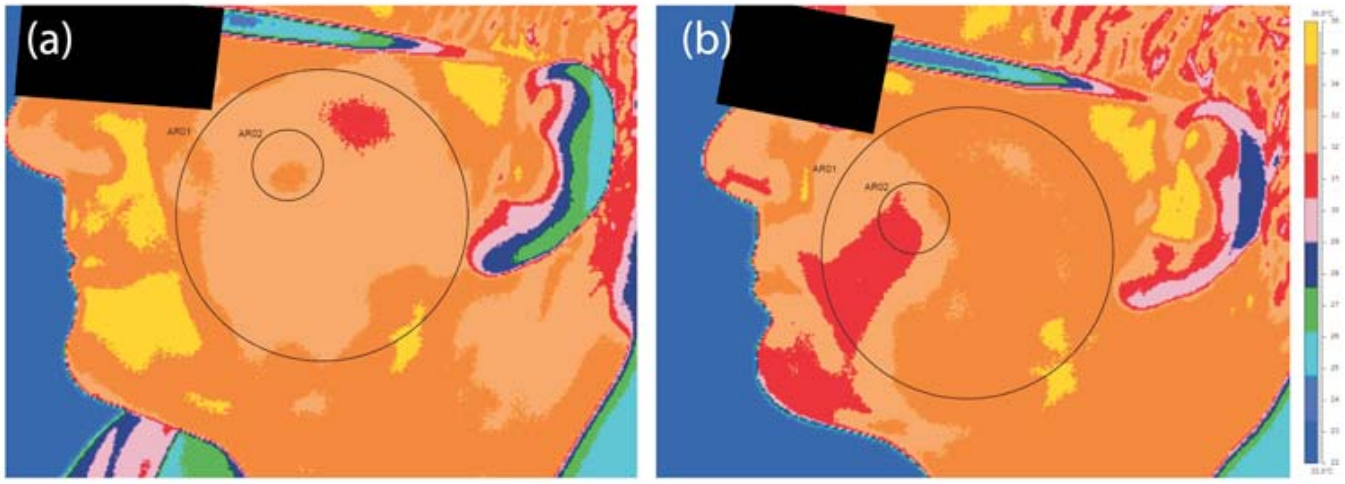

Figure 4
Left cheek thermal images of the patient taken before (a) and after (b) the removal of the root of the tooth 24

Source: Own research obtained by analyzing IRT images for patients examined at the ComfortDent Health and Stomatology Clinic in Katowice, using the FLIR Systems E60 and T640 thermal imaging camera, equipped with a microbolometric detector being a matrix FPA detector with a sensitivity of 0.05 and 0.03 K. Thermograms were analysed in the Therma-CAM Researcher Pro 2.10 software/system.

Conclusions

Thermal imaging gives important information about physiological changes in widely understood dental diseases. In all inflammatory conditions of soft tissues, we deal with temperature changes, which can be imaged with a thermal imaging camera. This technique not only provides a qualitative assessment but is also a method capable of a precise quantitative assessment of changes associated with clinical and subclinical inflammatory processes, as reported in our analysis and the work of other authors [45, 46]. Due to these undoubted advantages, thermal imaging has a chance to become a complementary diagnostic technique used in dentistry and even allow observing changes at an early stage of the development of various abnormalities, which on one hand may contribute to a faster therapeutic decision and may give information about the effectiveness of the treatment process. A certain limitation for this method is the depth at which the pathological changes are located. Thermal imaging of structures located directly on the skin surface or close to it does not pose any problems and becomes an important source of diagnostic information.

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General Assembly of the European Association of Thermology (EAT) 2021

Kevin Howell [1], Ricardo Vardasca [2], Kurt Ammer [3]

[1] President, [2] General Secretary, [3]Treasurer of the European Association of Thermology, Vienna, Austria

The 2021 General Assembly of the European Association of Thermology (EAT) was held online using the ZOOM platform (https://us02web.zoom.us/j/82612760313?pwd=cXVvdnk4SjlITjN3NFpYVW1EL2krUT09), due to the COVID-19 pandemic outbreak, on 15th October 2021 at 17:00 (European Central time)

The President Kevin Howell (KH) opened the General Assembly (GA) at 17h00, but because there were only 10 members with voting right, according to the statutes, having less than 50 percent of the existing members, it was postponed for 30 minutes.

KH resumed the GA at 17h30, with a total eleven ordinary members at the reopening of the GA.

1.Report of the EAT President

Kevin Howell (KH) welcomed all the present members to the GA. He reported that the biggest challenge to the EAT over the last 2 years had been the COVID-19 pandemic. Given that one of the EAT's core activities was the organisation of, and participation in, scientific meetings, the EAT have had to adapt rapidly to the online world.

Sadly, it had not been possible for EAT members to contribute to the meeting of the Polish Association in Zakopane over the past 2 years, but the EAT had been delighted to be a supporting organisation of the Sports Thermography meeting in Valencia last November, which was organised entirely online. As a delegate at this meeting, he had seen a great example of how to stage a congress online and do it well, and this experience came in very useful when it became the EAT's turn to run an online meeting in September 2021.

The EAT had hoped to bring the XV Congress of the EAT to Wroclaw in Poland for 2021, but we made the difficult decision to switch to an online meeting late in 2020, which gave us under a year to make all the necessary arrangements. KH was sure those of you who attended the XV Congress, and contributed to it, would all agree that the meeting was a great success. Forty-four delegates attended online, an in total there were thirty-three submissions presented in either poster, live presentation, or recorded video format. This achievement was down to the hard work of his colleagues on the EAT Board, the Scientific Committee under Kurt Ammer's chairmanship, and in particular Dr Maria Soroko and her local organising committee in Wroclaw. He thanked everyone involved..

Of course, another important focus for the EAT is education, and the Board felt it was very important to offer our Short Course on Medical Thermography in 2021, even if it had to be an online offering. He was pleased to report that ten students attended the day of teaching on 1st September, and feedback on this first attempt to teach online was generally very positive. He thanked the faculty for their enthusiasm for teaching this course, and for their flexibility, bearing in mind that some faculty members were delivering the first online lectures of their teaching careers!

The journal Thermology International remains an important part of the EAT strategy for disseminating high-quality thermological research. The EAT board are always striving to receive more submissions to the journal, and KH asked all members to promote Thermology International to their colleagues as a suitable journal for submitting any work in biomedical temperature measurement.

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After a significant re-design 3 years ago, the EAT website was now well-established and regularly visited by users across Europe and around the world. As webmaster, it remained rather challenging for KH to keep the pages completely up-to-date along with his other commitments, but generally he felt the EAT website did a good job at promoting the EAT and works well in unison with the EAT Twitter feed, which now has almost 300 followers.

Finally, although EAT membership had grown in 2021, the Board would still like to see more members, so KH asked members to continue to promote the EAT to their colleagues. A larger membership will allow better exchange of ideas on thermological topics across Europe, which is what the EAT has been striving for since its inception. KH was sure that the new EAT Board, when elected at the end of the meeting, would continue with this aim for all members through to 2024.

2.Report of the EAT Treasurer

Kurt Ammer (KA) reported that the Association currently had forty-six members, thirty-four of whom were ordinary members (including one affiliated national association),

nine were extraordinary members and three were lifetime honorary members.

The account summary was presented, showing that the EAT currently had €9273.47 in the bank account. He also presented the financial plan for the upcoming 3 years with the prospect of a balanced account despite the planning of a small scientific event annually.

3.Statement of the auditors

Peter Plassmann (PP) reported that the auditors (himself and John Allen (JA)) had examined the EAT accounts for the period 29.6.18 - 14.10.21. All transactions had been checked, and no irregularities had been found.

The statement of the auditors was accepted by the Assembly, and the accounts adopted.

4.Vote on accepting the financial report and plan, and acquittal of the EAT board members

The financial report and plan were approved by the Assembly with 1 abstention (KA).

The EAT board was discharged.

5.Election of the new EAT board

KH asked Ricardo Vardasca (RV) about any EAT Board proposal received, and RV confirmed that the only proposal received was from KH with the same names of the EAT board just discharged.

The proposed composition of the 2021 -2024 EAT board was therefore:

President - Kevin Howell

Vice-President - Anna Jung

Treasurer - Kurt Ammer

General Secretary - Ricardo Vardasca

General Board Members - Manuel Sillero and **Adérito Seixas**

The proposed EAT board was elected unanimously by all present at the Assembly.

The Board members accepted their roles.

KH commented that it was a great honour to be re-elected President of the EAT and thanked the membership for the trust they had invested in him. The Board would always do its best to develop the EAT for the benefit of its members and for the science of thermology.

6.Election of the 2 EAT auditors

KH proposed JA and PP to continue their role of EAT auditors.

The proposed EAT auditors were elected unanimously by all present at the Assembly.

7.Miscellaneous / Other issues

KA proposed to continue the EAT fee of 50.00 EUR for ordinary and extraordinary members. The Assembly agreed the value and unanimously approved it.

There being no other business the meeting was closed by KH, thanking all present, at 18:00.

2022

Thermology conferences

?

Due to the ongoing corona virus pandemic, reliable information on next year´s Thermology conferences in Europe is not yet available.

The traditional **conference of the Polish Association of Thermology in Zakopane** is unlikely to take place in spring or early summer of 2022. Organising it in autumn might be an option, if the COVID-19 pandemic is resolving.

QIRT has announced their **16th Congress in Paris, 4th -8th July at FIAP Jean Monet**. The Congress website is online at https://qirt2022.sciencesconf.org, but information on the format of the congress (again virtual as in Porto 2020 or with physical attendance or as a hybrid) is not yet available.

The **4th QIRT Asia** conference is postponed to Summer 2023 in **Harbin China.**

The conference **Thermosense: Thermal Infrared Applications XLIV** is scheduled for **3-7 April 2022 in Orlando, Florida, United States**. Submission of abstracts has closed on 6 October 2021.

The website https//spie.org/conferences-and-exhibitions /defense-and commercial-sensing/program proudly announced that conference **attendants will gather in person**. However, the conference organiser has to provide a safe meeting protocol based on federal state nd local regulations.

While participating in this event

- Do not attend if you are not feeling well
- Wash your hands frequently
- Be mindful of other attendees´comfort level
- Wear a mask in all indoor spaces

These requirements may change as the event approaches.