Incidence of iliotibial band friction and Baker's cyst in cases with isolated medial compartment knee osteoarthritis

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Purpose

Osteoarthritis is a major public health problem, with prevalence in the knee of approximately 30% in persons above age 65 [1]. The impact of osteoarthritis on the aging population in the industrialized world is illustrated by the fact that osteoarthritis is the major cause of disability in those over the age 65 years [2]. Cartilage loss in the medial compartment leads to varus deformity, which affects knee biomechanics. This may result in abnormal extension of the supporting structures of the lateral aspect of the knee. It can be cause of the increased friction of iliotibial band (ITB) [3]. It is well known that affection of soft tissue interposed between iliotibial band and lateral femoral condyle is called iliotibial band friction syndrome (ITBFS) reported as an overuse disorder that has been described in long distance runners, cyclists, military personnel, football players, and weight lifters [4,5-11]. This activation of fibrovascular tissue between ITB and lateral femoral condyle in osteoarthritis we previously described [12]. We have noticed the presence of popliteal (Baker) cyst in the patients with osteoarthritis. It is well known that Baker's cyst is the most frequent encountered lesion around the knee, as a painless palpable mass [13], with pain or can be detected during the routine MR imaging of the knee with suspected internal joint derangement [14]. Multiple studies confirmed that intraarticular derangement play an important role in pathogenesis of popliteal cyst. MR studies of popliteal cyst demonstrated connection to one or more intraarticular lesions in 87-98% of the cases, where effusion, meniscus tear and degenerative disease of the joint are found [15]. All of previously mentioned studies except ours, do not evaluated isolated medial compartment knee osteoarthritis.

The purpose of this study was to assess the frequency of MR signs of iliotibial band friction (ITBF) as well as Baker’s cyst in patients with advanced medial compartment osteoarthritis of the knee, and to correlate incidence and severity of those two entities concerning degree of cartilage and meniscal degeneration.
Methods and Materials

Within a period of 3 years, coronal and sagital PDw fatsat MR images (1.5T, SL 2.5-3mm) of 128 patients with isolated advanced medial compartment were analyzed for presence of ITBF and Baker's cyst. Out of them 41 were male and 87 female, with median age of 63 years.

On proton-density weighted (PDw) fatsat MR images (1.5-T, ST 2.5-3 mm, GE) was evaluated presence of complete or subtotal (>80%) loss of articular cartilage thickness at the weight bearing area of the medial condyles of femur and the tibia. Lateral compartment (articular cartilage, lateral meniscus and ligaments) was normal based on MR images.

The following parameters were graded: cartilage thickness of the medial and lateral compartment, degeneration of the medial meniscus, effusion and MR imaging signs of ITBF and distension Baker's cyst.

Thickness of cartilage and residual cartilage was measured, separately at the femur and tibia at weight bearing zone on medial and lateral compartment, followed by assessment of a thickness difference between medial and lateral compartment. Mucoid degeneration and the degree of disintegration of the meniscus was graded: 0- normal meniscus, 1- moderate degeneration with focal signal increase, 2- severe degeneration with some residual normal tissue and shape, 3-complete meniscal disintegration destroyed shape and no functional meniscal tissue. Lateral compartment including hyaline cartilage and lateral meniscus had to be normal without meniscal lesion or cartilage abnormalities.

For evaluation of MR signs of ITBF (0-not present, 1-present, 2 severe changes) the following criteria were used [4,16-18]: poorly defined signal intensity abnormalities lateral, distal or proximal to the lateral epicondyle; signal intensity abnormalities superficial or deep to the ITB; localized fluid collection lateral, distal or proximal to the lateral epicondyle (Fig. 1 and Fig2).

On MRI Baker cyst was presented as a circumscribed mass with low signal on T1-weigted image, intermedal signal intensity on proton density (PD) image and high signal intensity comparing with skeletal muscle on PD-weithed fatsat image. The size of Baker cyst was assessed by measuring the antero-posterior diameter of the cyst. Acording the size they were divided as small and large BC. When it is collapsed and no thicker than 1 cm than this is small not distended BC. Large or distended BC is with thickness up to 1 cm on antero-posterior diameter (Fig.3 and Fig.4).
An evaluation of transverse images was performed by the two observers separately and in a blinded fashion.

The following statistical tests were used: Mann-Whitney U test, Chi square test and Kappa Statistics for inter-rater-agreement.
**Fig. 1:** FIG 1a. A 72 y.o. man with medial osteoarthritis of the knee associated with MR imaging signs of iliotibial band friction (ITBF) and large Baker's cyst. Fibrovascular tissue (arrow) is seen between the lateral epicondyle and the ITB on PDw fatsat image. Complete loss of hyaline cartilage at the medial femoral condyle and the tibia plateau with advanced degeneration of the medial meniscus is obvious. The lateral compartment is normal (a).

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Fig. 2: FIG 1b. On axial PDw fatsat image minor effusion and extensive fibrovascular tissue between the lateral epicondyle and the ITB and large Baker's cyst are present (arrows, b).

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Fig. 3: Large Baker’s cyst in a 59-year old woman; a) Coronal PDw fatsat image shows complete cartilages lose on the medial knee compartment with 3th degree medial meniscus degeneration with degenerative disintegration, the lateral compartment is normal including the hyaline cartilage and the lateral meniscus.

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**Fig. 4: b)** Axial PDw fatsat image demonstrates a large Baker's cyst, with septum within the cyst.

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Fig. 5: Fig 3a. A 70 y.o. woman with medial osteoarthritis of the knee associated with MR imaging signs of iliotibial band friction (ITBF) and large Baker's cyst. Fibrovascular tissue (arrow) is seen between the lateral epicondyle and the ITB on PDw fatsat image. Joint effusion is present (a).

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**Fig. 6:** Fig 3. Some slices posterior the complete loss of hyaline cartilage at the medial femoral condyle and the tibia plateau with advanced degeneration of the medial meniscus is obvious. The lateral compartment is normal (b).

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Fig. 7: Fig. 3c. On axial PDw fatsat image minor effusion and extensive fibrovascular tissue between the lateral epicondyle and the ITB and large Baker’s cyst are present (arrows, c).

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Results

From 128 patients with isolated severe medial compartment osteoarthritis of the knee, 41 (32%) were male and 87 (68%) were female with a mean age of 63 years (range 34-89 year). Complete cartilage loss in medial compartment was present in 69 patients (53.9%), a subtotal loss of cartilage in 59 patients (46.1%) (Table 1). The difference of cartilage thicknesses in the medial and the lateral compartment was statistically significant (p< 0.01), mean cartilage thickness in the medial compartment 0.65 mm, in the lateral compartment 5.45 mm. In the majority of the patients (89 pts, 69.5%) a complete degenerative disintegration of the medial meniscus without functional meniscal tissue was present. From these 89 patients, 58 showed a complete cartilage loss and 31 patient had subtotal loss of hyaline cartilage.

MR imaging signs for ITBF were present in 95 patients (74.2%). Out of them 91 patient had moderate signs for ITBF (51 cases in group with complete cartilage loss and 40 cases in group with subtotal cartilage loss) and 4 had severe MR imaging signs for presence of fibrovascular tissue along ITB (2 cases in each group, with complete and with subtotal cartilage loss) (Table 1). Mann-Whitney U test found no significant difference between complete/subtotal cartilage loss and different degree of medial meniscal degeneration and presence of signs of ITBF (p>0.05).

Patients with complete cartilage loss as well as patients with subtotal cartilage loss showed tendency to further increase the incidence of MR imaging signs of ITBF, when complete degenerative disintegration of the medial meniscus was present.

Statistical analysis using the Mann-Whitney U test showed for the data from reading only axial images a highly significant difference for both readers independently (p = 0.000) for the presence of MR signs of ITBF and BC.

Pearson chi-square test showed correlation between both observer according MR signs of ITBF ($\chi^2 = 25.52\; \text{df}=4\; p=0.00004$). Inter-rater-agreement for the evaluation of all cases was good with a Kappa value of 0.60.

Out of 128 MR images, Baker's cyst were found in 66 cases, 23 were male, 43 female with a mean age of 56.4 years (range 34-84 year). Large Baker cyst was found in 31 cases (47%) and 35 cases (53%) had small cysts (Table 1).

In the group with large Baker cyst, in 26/31 cases (84%), medial compartment complete cartilage loss was present in 15 cases and subtotal cartilage loss in 11 cases, with different degree of medial meniscus degeneration (fig.3).
In the cases with small Baker's cysts, which represent 48.4% (17/35 cases), medial compartment complete cartilage loss was present in 10 cases and subtotal cartilage loss in 7 cases, with different degree of medial meniscus degeneration.

There was no statistically significant difference between both groups for the presences of medial compartment cartilage loss with p<0.05 (Mann-Whitney U test).

In the group with large Baker cyst Chi-square test showed statistically significant difference between different degree of medial meniscus degeneration and distension of Baker cyst (Chi-square=8.6; df=2, p<0.01). This difference was not present in the group with small Baker cyst (Chi-square=1.8; df=2; p=0.4).

When complete cartilage loss is present, 32 (46.4%) cases have mild form of ITBF without presence of Baker cyst. We have got similar situation in the group with the subtotal cartilage loss - 27 (45.8%).

In the group with complete cartilage loss 12 (17.4%) cases had mild form of ITBF and distended Baker cyst. Smaller was the percentage (11.9%) of the cases with mild form of ITBF and large BC in the group with subtotal cartilage loss.

Mild form of ITBF and small BC was present in the same percentage (10%), in the both groups, group with complete as well as subtotal cartilage loss at medial compartment.

There was no statistically significant difference between presence of ITBF and BC in group with subtotal cartilage loss (Chi-square=1.9; df=4; p=0.7), as well as in the group with total cartilage loss (Chi-square=4.8; df=4; p=0.3).

Kruskal-Wallis ANOVA by Ranks for ITBF and for BC as independent variables separately, shows no statistical difference in both groups (graphic 1).

Only when we correlated both groups, group with complete and group with subtotal cartilage loss, with different degree of medial meniscus degeneration for presence of ITBF and BC, there was statistically significant but weak negative correlation (Speraman's r=-0.36; p<0.01).
Conclusion

MRI sign of ITBF and BC are frequently present in patients with severe medial compartment knee osteoarthritis. There is a strong association between entities and the severity of the medial compartment osteoarthritis, emphasizing the importance of cartilage degeneration for the distension of Baker cysts and severity of ITBF.

This entities can be an additional cause of atypical localization of the pain in osteoarthritis that has to think about and can be an explanation of lateral knee pain in cases associated with ITBF and posterior knee pain when Backer's cyst is distended.
References


Personal Information

PERSONAL DETAILS

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UNDERGRADUATE/MEDICAL/GRADUATE

1986-1992 College/Medical School, University "Ss. Cyril and Methodius" Skopje, Republic of Macedonia

1993-1996 Master degree in Medicine, Medical School, University "Ss. Cyril and Methodius" Skopje, Republic of Macedonia

06/04/2001 Defended Master Thesis "Ultrasound diagnosis of appendicitis" Medical School, University "Ss. Cyril and Methodius" Skopje, Republic of Macedonia


INTERNERSHIP

1992-1993 INTERSHIP: Surgery, Medicine, Internal medicine, Pediatrics at Medical School, University "Ss. Cyril and Methodius" Skopje, Republic of Macedonia

RESIDENCY
1995-2000 Resident in Diagnostic Radiology, Institute in Radiology, Medical School, University "Ss. Cyril and Methodius" Skopje, Republic of Macedonia

**FELLOWSHIPS**

Sep - Dec 2003 University Clinic for Radiodiagnostic, Department of Osteology, AKH Vienna, Austria, Prof. H. Imhof

Nov - Dec 2004 University Clinic "La Sapienca", Radiology department, Roma, Italy, Univ. Prof. Passarielo and Prof. C. Catalano

2005 / 2006 University Clinic for Gastroenterohepathology, Departement for Ultrasonography, "Extravascular Interventional procedures", Skopje, Macedonia, Prof. V. Serafomovski and Prof. Neskovski

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1992 Graduated from the Faculty of Medicine, Diploma gained: Medical Doctor, University "St. Cyril and Methodius" Skopje

2000 *Trained in radiology*, at the Institute of radiology, Medical faculty, University "St. Cyril and Methodius" Skopje, Republic of Macedonia - Certificate Specialist exam Radiodiagnostic

2001 *Master of science degree in diagnostic radiology*, Medical faculty, University "St. Cyril and Methodius" Skopje, Republic of Macedonia - Certificate for expert title Master of Artist in Medical Science

2002 - 2009 *Assistant at Medical faculty*, University "St. Cyril and Methodius" Skopje, Republic of Macedonia

2010 - 2014 Associate Professor (Docent) at Medical faculty, University "Ss. Cyril and Methodius" Skopje, Republic of Macedonia
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Languages:

English, Serbian, Croatian, Slovenian, Bulgarian - fluent

German and Italian - working knowledge.

PROFESSIONAL EXPERIENCE

1992 - 1995 General Practitioner, Surgery Department, Orthopedics and Traumatology, Department of Urology, Surgery Clinic "St. Naum Ohridski" Skopje, Macedonia

2000 - present Specialist in Diagnostic Radiology, Department for diagnostic radiology, University Surgery Clinic" St. Naum Ohridski", Skopje (Musculoskeletal Imaging)

2003 - present Working at Interventional Extravascular procedures

RESEARCH PROJECTS:

1995 "Verbal expression of born Macedonian speakers with brain damage from different ethiology.

1998 "Macedonian multicentric study for lethal skeletal dysplasias"

2003 Diagnostic quality of digital and conventional radiographs of the hip and knee in the assessment of endoprotheses.

2003 MDCT versus digital radiography in the evaluation of bone healing in orthopedic patients.
2010 "Environmental and health Impact of fly-ash nanoparticles and their inertization into polymer based nanocomposites" ID = 248136.

2010 "Development of Eco-Innovative, sustainable and green technologies, products and practical onsite system solutions for environmentally friendly recycling and reuse of construction and demolition wastes " ID = 265349.

ACADEMIC APPOINTMENTS

2003 - 2010 Assistant Professor, Department of Diagnostic Radiology, University Clinic of Radiology, Medical Faculty, University "Ss. Cyril and Methodius", Skopje Macedonia

2010 - 2014 Associate Professor (Docent), Department of Diagnostic Radiology, University Clinic of Radiology, Medical Faculty, University "Ss. Cyril and Methodius", Skopje Macedonia

2015 - present Professor, Medical Faculty, University "Ss. Cyril and Methodius", Skopje Macedonia

CERTIFICATIONS

1992 MD General Practice
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Diploma gained: Medical Doctor, University "St. Cyril and Methodius" Skopje, Macedonia

2000 Specialist in Diagnostic Radiology
Certified by State Board of Radiology, Macedonia
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2001 Master of science degree in diagnostic radiology,
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2009 Doctor of science degree in diagnostic radiology,
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1992 MD General Practice
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2000 Specialist in Diagnostic Radiology
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MEMBERSHIP IN PROFESSIONAL SOCIETIES

1997 - present Macedonian Society of Radiology

1997 - present European Society of Radiology - ESR

1999 - present Sarcoma consilium board, State board for management of musculoskeletal tumors - Macedonia

2002 - present European society of Skeletal Radiology - ESSR

2006 - present Society of Gastroenterohepathology of Macedonia
2008 - present Balcan Society of Radiology - BCR

2014 - present European Society of Neuroradiology - ESNR

COMMITTEES OF THE PROFESSIONAL SOCIETIES

2005 - present Tumor subcommittee for European society of Skeletal Radiology - ESSR

2009 - present Sports imaging subcommittee for European society of Skeletal Radiology - ESSR

2012 - present Musculoskeletal imaging subcommittee for European society of Radiology - ESR

ATENDANCE OF CONGRESSES AND EDUCATIONAL COURSES:

1997 I attended 1st Balkan Congress of Orthopedics-Thessalonica, October 8-11;

1998 EUROSON 98-SFAUMB 98,10th Congress of EEFSUMB-19th Congress of SFAUMB, March 26-30, Tours, France;

1999 I attended European Seminar on Diagnostic and Interventional Radiology, June 2-5, Copenhagen, Denmark;

2000 Head and Neck Imaging and Intervention, May 17-20, Brescia, Italy;

2000 ESSR European Society of Musculoskeletal Radiology, October 27-28, Leiden, The Netherlands;

2001 Liver, biliary tract and pancreas: imaging and intervention , June 7-9, Berlin, Germany;

2001 European Society of Urogenital Radiology, September 14-16, Rotterdam, the Netherlands

2002 Kurs Fuer Fortgeschrittene und Fachaerzte", Dez12-14, Wien, Austria
2003 Visiting Doctor at Univeritaetsklinik fuer Radiodiagnostik, Klin. Abteilung fuer Osteologie AKH-Viena, Austria, Univ.-Prof. Dr.H.Imhof, from 1st September-30th November;

2004 EUROSON 2004-European Congress on Ultrasound in Medicine and Biology, june 5-8, Zagreb, Croatia;

2004 11th Annual Meeting of the European Society of Musculoskeletal Radiology, June 18-19, Augsburg, Germany

2004 Visiting Doctor at University clinic "La Sapienza" Roma, Italy, Radiology department, Prof. Dr. Passarielo. Nov.-Dec.2004;

2005 BSSR ESSR Congress - Congress of British and European Societies of Skeletal Radiology, July, 7-9, Oxford, UK;

2006 ECR European Congress of Radiology, March, Vienna, Austria

2006 WFUMB World Congress of Ultrasound in Medicine and Biology, May, Seoul Korea

2006 13th European Society of Skeletal Radiology - ESSR Congress, June 13-14, Bruges, Belgium

2007 European Congress of Radiology - ECR, 9-13 March, Vienna

2007 14th European Society of Skeletal Radiology -ESSR Congress, June 1-2, Izmir, Turkey

2008 European Congress of Radiology - ECR, 7-11 March, Vienna

2008 15th European Society of Skeletal Radiology / British Society of Skeletal Radiology and Faculty of Radiologist of the Royal College of Surgeons in Irland-ESSR/BSSR/RCSI Congress, June 12-14, Galway, Irland

2009 European Institute for Biomedical Imaging Research - EIBIR educational workshop of selected topics on molecular imaging, May 7-8.

2009 European Congress of Radiology - ECR, 9-13 March, Vienna

2010 European Congress of Radiology - ECR, Vienna, Austria

2010 17th European Society of Musculoskeletal Radiology Meeting -ESSR, June 17-19, Lille, France

2011 European Congress of Radiology - ECR, 2-7 March, Vienna
2011 ESSR, Krit, Grece - Invited lecturer
2011 ICIS, International Cancer Imaging Society, Copenhagen, Denmark
2012 European Congress of Radiology - ECR, March, Vienna
2012 ESSR, Innsbruck, Austria - Invited lecturer
2012 Sports Imaging meeting, ESSR, Istanbul, Turkey
2012 Balkan Congress of Radiology, Oct., Sandanski, Bugaria - Invited lecturer
2013 European Congress of Radiology - ECR, March, Vienna
2013 ESSR, Marbella, Spain - Invited lecturer, Moderator
2013 Balkan Congress of Radiology, Oct., Ohrid, Macedonia - Invited lecturer, Moderator
2014 European Congress of Radiology - ECR, March, Vienna
2014 ESSR, Riga, Latvia
2014 Heidelberg Summer school, 27-28 June - Musculoskeletal radiology
2014 ISS - October 15-18, Edinburg, Scotland

REVIEWER IN PEER REVIEW JOURNALS

2010 - present Contributions: Macedonian Academy of Sciences and Arts, Section of Biological and Medical Sciences.

2011 - present Acta morphologica

2013 - present Acta Orthopedica

TEACHING EXPERIENCE

2010 - present Department of Diagnostic radiology, University Surgical Clinic "St.Naum Ohridski", Medical Faculty, University "Ss. Cyril and Methodius" Skopje, Republic of Macedonia

(Lecturing and education of Medical students, Technologist and Residents)
2011 - present Medical School for Radiographers, University "St. Kliment Ohridski" Bitola, Republic of Macedonia

(Lecturing in Radiologic anatomy, Computed tomography and Magnetic resonance imaging)

2011 European Skeletal Society of Radiology - ESSR, Crete, Greece
"Case discussion session"

2011 International Congress of Pathology, Ohrid, Macedonia
"Bone tumors and tumor like conditions: Analysis with conventional radiography"

2012 European Skeletal Society of Radiology - ESSR, Innsbruck, Austria
"Radiographical features of bone tumors in hand and wrist"

2012 Balcan Congress of Radiology, Jane Sandanski, Bulgaria
"Imaging of musculoskeletal soft tissue tumors"

2012 Conference of Radiological society of Macedonia
"Hand and wrist trauma"

2012 Conference of Radiological society of Macedonia
"Bone tumors and tumor-like conditions Analysis with conventional radiography"

2012 Conference of Radiological society of Macedonia
"Bone tumors of hand and wrist"

2013 Balcan Congress of Radiology, Ohrid, Macedonia
"Wrist and carpal injuries"

2013 EMSA (European Medical Student Association) workshop for Medical students
3 hours "Bone tumors and tumor-like conditions, analysis with conventional radiography"

2013 EMSA (European Medical Student Association) workshop for medical students

3 hours "Tumors of Musculoskeletal system"

2013 EMSA (European Medical Student Association) workshop for medical students

3 hours "Radiologic diagnostic of the skeleton, normal radiologic anatomy and traumatic skeletal changes"

2014 - present Continued Medical Education

Medical Faculty, Skopje, Macedonia

2014 - present University "St.Kliment Ohridski" Bitola, Macedonia

Residence on Magnetic resonance for Radiographers

30 hours "Physical principles of Magnetic Resonance Imaging"

30 hours "Protocols for Magnetic Resonance Imaging"

30 hours "MRI anatomy"

2014 EMSA (European Medical Student Association) workshop for medical students

3 hours "Radiologic diagnosis of Tumors of Musculoskeletal system"

2014 EMSA (European Medical Student Association) workshop for medical students

3 hours "Multidisciplinary approach in management of musculoskeletal tumors"

PROFESSIONAL INTERESTS

Musculoskeletal Radiology (MR, US, CT, interventional procedures)

Imaging Guided Biopsy of Musculoskeletal tumors

General Radiology
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Fibrovascular activation of MCL as significant indirect sign for vertical tears of the posterior attachment of the medial meniscus (VTPAMM) ESSR, Lille, France, June 2010.

ESSR, Lille, France, June 2010.

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43. **Vasilevska Nikodinovska V**. Radiological features of bone tumors. ESSR June 2012, Innsbruck, Austria - *invited lecture*

44. **Vasilevska V**, Jordanoska E, Nevece I, Spirov G, Samargiski M, Kostadinovska Kunoska S. Imaging features of aneurismal bone cysts. ESSR June 2012, Innsbruck, Austria. - *oral presentation*


47. **Vasilevska Nikodinovska V**. Medial collateral ligament activation. Is this a significant indirect sign for posterior attachment vertical tear of medial meniscus? ESSR June 2013, Marbella, Spain. - *oral presentation*


49. **Vasilevska Nikodinovska V**. Wrist and carpal injuries. XI\textsuperscript{th} Balkan Congress of Radiology, 03-06 Oct.,Ohrid, Macedonia -2013 - *invited lecture*

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Fig. 8: Prof. Violeta Vasilevska Nikodinovska MD PhD

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