Molecular epidemiology of *Trichophyton mentagrophytes* – a new approach

Silke Uhrlaß¹, Ivan M. Pchelin², Ali Rezaei-Matehkolaei³, Shyam B. Verma⁴, Resham Vasani⁵, Daniela Koch¹, Franziska Wittig¹, Constanze Krüger¹, Pietro Nenoff¹

¹Laboratory for Medical Microbiology, Mölbiser Hauptstraße 8, Mölbis, Germany
²Kashkin Research Institute of Medical Mycology, I.I. Mechnikov North-Western State Medical University, St. Petersburg, Russia,
³Department of Medical Mycology, School of Medicine, and Health Research Institute, Infectious and Tropical Diseases Research Center, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran
⁴“Nirvan” and “In Skin” Clinics, Vadodara, Gujarat, India
⁵Kingsway Clinic, Matunga, India

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Objectives: According to the new taxonomy of dermatophytes, the former *Trichophyton (T.) mentagrophytes* (TM)-complex is now differentiated into *T. mentagrophytes* (zoophilic strains) and *T. interdigitale* (TI, anthropophilic strains). Other zoophilic species with a similar source of infection are *T. quinckeanum* as well as *T. benhamiae* (isolated from guinea pigs) and *T. erinacei* (found on hedgehogs). This study analyzes the clustering of TM and TI according to the genotype of the ITS region of the rDNA.

Patients and methods: About 40 clinically isolated strains of TM and TI were investigated between 2015 and beginning of 2018. TM strains from an Indian clinical study were included. All strains were identified by conventional laboratory methods based on an in-house PCR- ELISA as well as macroscopic and microscopic morphology. Sequences of the ITS region of these strains were aligned with reference sequences obtained from the database of the National Center for Biotechnology Information (NCBI) in Bethesda, Maryland and used to generate a phylogenetic tree (see Fig. 1). Russian and Iranian sequences were also included. All strains were clustered into genotypes according to their geographical origin and/or animal host as source of infection (see TM cluster names).

Phylogenetic tree - Genotype clusters of ITS rDNA of TI and TM

Fig. 1: PhyML 3.1, Maximum Likelihood method, branch support -Bootstrap method Replications – 1000, Substitution Model: GTR, rooted with *T. quinckeanum* by Ivan M. Pchelin

Results: Genotype clusters based on the ITS region rDNA

- T. interdigitale* 1- ITS Type I**
KC595991.1, NCBI Accession no., Tunisia
208223_17, Lab Mölbis routine, Germany, Tinea pedis, female, 81 y
- T. interdigitale* 2- ITS Type II**
KP308373.1, NCBI Accession no., strain RCPF 1301, Russia
200070_17, Lab Mölbis routine, Germany, Onychomycosis, male, 61 y
- T. interdigitale* 3- ITS Type II***
D15P152_17, Ivan M. Pchelin, Russia, intermediate genotype, Tinea faciei
212063_17, Lab Mölbis routine, Germany, Tinea corporis (neck), male, 29 y
- T. mentagrophytes* Germany Type 1- ITS type III***
900120_17, Lab Mölbis routine, Germany, Tinea faciei, male, 44 y
217907_15, Lab Mölbis routine, Germany, Tinea capitis, male, 7 y
218893_16, Lab Mölbis routine, Germany, Tinea capitis profunda, male, 8 y
LN736306.1, NCBI Accession no. strain CCF 4473, Czech Republic
D15P127_16, Ivan M. Pchelin, Russia,

Clinical examples with strains of the genotype cluster TM

- T. mentagrophytes* snow leopard - ITS Type III**
KT253559.1 NCBI Accession no., strain RCPF-1207, Russia
KJ606099.1 NCBI Accession no., strain ATCC 60612
KX866689.1, NCBI Accession no., strain 200002_16, Lab Mölbis, snow leopard, Switzerland
217704_15 Lab Mölbis routine, Tinea, male, 50 y, zoo keeper, Switzerland
- T. mentagrophytes* India - ITS Type VIII**
211509_17_W, Study India, Dr. Shyam Verma, Vadodara, West India, Tinea
200095_18_S, Study India, Chennai, South India, Tinea corporis
216500_17_N, Study India, Lucknow, North India, Tinea corporis
1733_E, Study India, East India, Tinea
KY761968.1, NCBI Accession no., isolate D15P135, Mumbai, India
JN133999.1, NCBI Accession no., isolate 490, Iran
KT192468.1, NCBI Accession no., strain Ahv-18, Iran
HQ014707.1, NCBI Accession no., strain WM10.87, Oman
EU200375.1, NCBI Accession no., strain 05-297-2873, Australia
D15P135_16, Ivan M. Pchelin, Russia, Travelers returning from India
- T. mentagrophytes* Australia - ITS Type IX**
214691_17, Lab Mölbis routine, Germany, Tinea corporis, female, 39 y
Travelers returning from Australia= new
- T. mentagrophytes* Germany Type 2- ITS type IV**
200617_17, Lab Mölbis routine, Germany, Tinea corporis, female, 7 y
200602_17, Lab Mölbis routine, Germany, Tinea corporis, female, 26 y
204543_17, Lab Mölbis routine, Germany, Tinea, female, 11 y
FM986773.1, NCBI Accession no., strain SJEK4836
- T. mentagrophytes* Russia - ITS Type VI**
D15P161_17, Ivan M. Pchelin, Russia, cat = new
- T. mentagrophytes* Thailand - ITS Type VII**
JN134101.1, NCBI Accession no., strain NBRC 5809
210363_16, Lab Mölbis routine, Germany, Tinea genitalis (Mons pubis)
218904_16, Lab Mölbis routine, Germany, Tinea, male, 29 y
215003_16, Lab Mölbis routine, Germany, Tinea genitalis, 16 y
200128_17, Lab Mölbis routine, Germany, Tinea, male, 29 y
- T. mentagrophytes* Iran - ITS Type V**
KJ606098.1, NCBI Accession no., strain ATCC 46950
P-160, Ali Rezaei-Matehkolaei, Iran, sheep and goat
P-161, Ali Rezaei-Matehkolaei, Iran, sheep and goat
P-162, Ali Rezaei-Matehkolaei, Iran, sheep and goat

Conclusion: Due to recent taxonomy changes of dermatophytes, the sequences of TI and TM deposited in databases do not allow an exact assignment of the respective species and genotype. Based on Sanger sequencing results of the ITS region of the rDNA, we demonstrate every zoophilic TM strain corresponding to one of the eight genotype clusters. TI shows three ITS genotypes, only. An ITS nomenclature code was introduced for TI and TM cluster classification. Existing NCBI TM sequences were not considered if no clinical isolate was present in this study. Hence, further TM sequences need to be integrated into our suggested clusters.