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Unravelling the mystery of Nanga Parbat

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Abstract Since the disappearance of Günther Messner, brother of the world-famous mountaineer Reinhold Messner, on an expedition to Nanga Parbat in 1970, the circumstances of his death have given rise to controversy. Reinhold Messner claimed that he and Günther descended the Diamir face together when an avalanche killed his brother, while other expedition members argued that Günther was abandoned by Reinhold to descend the Rupal face. Now, 35 years after the event, Günther's remains have been found at the Diamir face and have been identified by forensic DNA fingerprinting. The location of the remains supports Messner's version, thus putting to rest one of the climbing communities' most publicised controversies.

Keywords Messner · Mitochondrial DNA · SNP screening · Y-STRs · Identification · Forensic DNA typing

Introduction

Since 1970, the world's ninth highest mountain Nanga Parbat (8,125 m) has been at the centre of public controversy, when the famous mountaineer Reinhold Messner's brother Günther did not return from their attempt to be the first to climb the summit via the difficult east-oriented Rupal face. While Reinhold stated later that Günther was swept away by an avalanche during their descent through the easier, west-oriented Diamir face, former climbing partners doubted this version and accused Reinhold for having abandoned his enervated brother during the difficult ascent in a bid for the glory of the summit victory. Reinhold Messner, refuting these claims and the controversy surrounding Günther's death, returned to Nanga Parbat several times to search for signs of his brother, as the

location of his remains would be a vital key to the truth of his assertion.

In 2000, climbers found a human fibula at an altitude of 4,300 m at the Diamir face, which was initially believed to originate from a victim of another, later accident. In 2003, however, when the victim of the later accident was identified, this fibula was subjected to forensic DNA analyses to evaluate potential kinship with the Messner family. In 2005, additional remains were discovered in the vicinity of the earlier location, and a proximal phalanx protected in a mountain boot was subjected to forensic DNA typing.

Materials and methods

Bone samples were sanded and bleached prior to milling. Lysis and DNA extraction (phenol/chloroform) of the bone powder was performed according to Köchl et al. [1]. DNA of buccal scrape samples—provided by Reinhold and Hubert Messner—were Chelex extracted [2]. Amplification was carried out using the AmpFLSTR Identifier, Yfiler and SGM Plus PCR Amplification Kits (all from Applied Biosystems, Foster City, CA, USA) according to the manufacturer's recommendations, and a homemade mini-short tandem repeat (STR) multiplex [3]. All PCR reactions were carried out in a Perkin Elmer 9600 thermal cycler; amplification products were electrophoresed on a CE3100 Genetic Analyzer (Applied Biosystems) using POP 6 and default conditions. Data were analysed using GeneScan Analysis (version 3.7) and Genotyper (version 3.6). Mitochondrial DNA (mtDNA) SNP screening was carried out as described by Brandstätter et al. [4]; control region sequencing was performed as outlined by Parson et al. [5] and Brandstätter et al. [6].

Results

The human fibula recovered in 2000 gave only partial STR profiles (SGMplus), obviously due to DNA degradation;

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Table 1 Results of autosomal STR profiling

Sample	Amelogenin	D3S1358	vWA	D16S539	D2S1338	D8S1179	D21S11	D18S51
Fibula	X/Y	14/19	14/17	10/12	20/23	13/14	n.r.	12/15
Proximal phalanx	X/Y	14/19	14/17	10/12	20/23	13/14	29/34	12/15
Reinhold Messner	X/Y	14/19	17	10/11	20/25	14	29/32.2	13/15
Hubert Messner	X/Y	16/19	14/17	11/12	25	13/14	30/32.2	12
Sample	D19S433	TH01	FGA	D7S820	CSF1PO	D13S317	TPOX	D5S818
Fibula	14/15	6/9	21/23	n.r.	n.r.	n.r.	n.r.	n.r.
Proximal phalanx	14/15	6/9	21/23	11/12	10/11	11	8/9	11/13
Reinhold Messner	14/16.2	6	22/24	10/12	10/12	11	8/9	12/13
Hubert Messner	14/16.2	6	21/23	11/12	10/11	11/12	8/9	11/13

The STR loci were typed with AmpFLSTR Identifier and SGM Plus PCR Amplification Kits (both from Applied Biosystems) and a homemade mini-STR multiplex [3]

n.r. no result

four STR loci and the gender-specific amelogenin gave successful results. Mini-STR typing [3] gave useful results in five additional loci, yielding a consensus male profile in a total of nine STR loci (Table 1). Likelihood-based kinship calculations (using Charles Brenner's DNAVIEW software, Berkeley, CA, USA) including the STR profiles obtained from the fibula and the two living brothers, Reinhold and Hubert Messner, indicated strong evidence for brotherhood (Likelihood ratio; LR=81,900). Y-STR typing failed to give a clear result. MtDNA SNP screening and sequence analysis of the control region gave identical results between the fibula and the two reference samples. The mtDNA SNP analysis revealed haplogroup U status [4], which was confirmed by the control region profile A16233G C16256T T16311C A16343G C16355T A73G C150T A263G 309.1C 315.1C A523del C524del (haplogroup U3). This haplotype has yet not been observed in more than 30,000 records ([7, 8] and unpublished data); thus, further corroborating the probability of maternal kinship.

The proximal phalanx analysed in 2005 harboured high-quality DNA and yielded a full male STR profile in 15 loci (Identifier, Table 1). The results confirmed the earlier findings, and likelihood ratio calculations indicated an 18 million times higher chance of brotherhood between the DNA of the proximal phalanx and Hubert and Reinhold Messner than the alternative scenario (that the bone originated from an unrelated person). Brotherhood was further supported by the analysis of 17 Y-STR loci (Yfiler), which resulted in a full match between the three samples, again failing to exclude kinship through the paternal lineage. The minimal haplotype of this Y-STR profile (DYS19 15, DYS389 12/28, DYS385 15/16, DYS390 22, DYS391 10, DYS392 11 and DYS393 15) has yet not been observed in a worldwide database of 34,558 individuals (Y Chromosome Haplotype Reference Database, release 17; <http://www.yhrd.org/index.html>). Finally, mtDNA control region sequencing also confirmed the earlier findings.

In conclusion, the results of forensic DNA profiling permit no reasonable doubt that the analysed bone samples indeed belong to a brother of Reinhold and Hubert

Messner. Now, with the discovery of Günther Messner's remains on the Diamir face of Nanga Parbat, one of Himalayan mountaineering's greatest controversies appears to be resolved.

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