Onychomycosis is the most common disorder of the nail plate. *Trichophyton rubrum*, the organism most abundant during onychomycotic infections, is known to embed within the nail, produce keratinolytic proteinases and change the visual characteristics of the local tissue, but there is not, at present, a clear understanding of how the infection impacts the nail integrity. The hard, yet slightly elastic structure of the nail plate is believed to be at least in part a consequence of extensive keratin disulphide links (-SS-). Breakage of disulphide bonds, consequently generating -SH groups, often result in a reduction in barrier function. The aim of this work was to characterize the -SS- bonds in healthy and onychomycotic nails and investigate the link between -SS- bonds and nail barrier integrity.

Raman infrared spectroscopy was used to characterise the -SS- and -SH bonds on the dorsal and ventral sides of 4 healthy fingernail clippings, 4 healthy toenail clippings and 4 diseased toenail clippings. Tris(2-carboxyethyl)phosphine (TCEP) was used as a positive control and nail barrier integrity was determined using rhodamine B and water as markers. The Raman spectra (Fig.1) showed that healthy nails have a high content of -SS- bonds, in agreement with previously published work. Upon treatment with TCEP, nail -SS- bonds are reduced and -SH groups are formed as shown by the presence of the -SH band in the raman spectrum. Interestingly, the Raman spectra of diseased nails showed that the -SS-content remains high and comparable to that of healthy nails and no -SH groups are evident. Rhodamine B and water ingress (measured as nail swelling) into the nail were significantly lower in nails with a high proportion of -SS- bonds (rhodamine penetration: 0.16 ± 0.07 µg/mg and nail swelling: 15.21±1.54% weight increase) than in nails containing a proportion of -SH (rhodamine penetration: 0.39 ± 0.03 µg/mg and nail swelling: 277.02 ± 29.75% weight increase).

The data presented herein suggest that the human nail plate barrier properties are at least in part a function of -SS- bond integrity and that these bonds are retained in onychomycotic nails.

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References