Purpose:
Signal distortion is commonly observed when using independent component analysis (ICA) to remove maternal cardiac interference from the fetal magnetocardiogram(fMCG). This can be seen even in the most conservative case where only the independent components dominated by maternal interference are subtracted from the raw signal, a procedure we refer to as independent component subtraction (ICS). Distortion occurs when the subspaces of the fetal and maternal signals have appreciable overlap. To overcome this problem, we propose a new method for reducing the signal distortion.

Methods:
we employed splining to remove the fetal signal from the maternal source component. The maternal source components were downsampled and then interpolated to their original sampling rate using a cubic spline. The splined maternal source components were projected back onto the magnetic field measurement space and then subtracted from the raw signal. The method was evaluated using data from 24 subjects. We compared the results of conventional, i.e. unsplined, ICS with our method, splined ICS, using matched filtering as a reference. Correlation and subjective assessment of the P-wave and QRS complex were used to assess the performance.

Results:
Using ICS, we found that the P-wave was adversely affected in 7 of 24 (29%) subjects, all having correlations less than 0.8. Splined ICS showed negligible distortion and improved the signal fidelity to some extent in all patients. We also demonstrate that maternal T-wave interference can be problematic when the fetal and maternal heartbeats are synchronous. In these instances, splined ICS is more effective than matched filtering.

Conclusions:
Splined ICS overcomes the problem of ICA signal distortion that has limited its utility for assessment of fetal rhythm. The method is very simple to implement and is suitable for routine processing of fMCG recordings.