Supplementary Material

Biological bone micro-grinding: anisotropy-based performance evaluation and optimization

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Table S1 List of symbols

Symbol	Description	Symbol	Description
C_2,C_3,C_4	Material mechanical parameters	n	Spindle speed
C_h	Transverse crack	R_0	Radius of the spherical grinding head base
C_{ij}	Components of the right Cauchy deformation tensor (i,j = 1,2,3)	s	Historical time variables
C_l	Radial crack	S^e	Second Piola-Kirchhoff stress tensor for the elastic component
E	Modulus of elasticity of the material	t	Time
F_n	Normal micro-grinding force in the effective grinding zone	t_0	Time for a single grinding cycle
F_{n1}	Normal micro-grinding force of a single grit in the ductile removal phase	t_1	Static load time
F_{n2}	Normal micro-grinding force of a single grit in the brittle removal stage	W	Strain energy function
F_t	Tangential micro-grinding force in the effective grinding zone	W_{ani}	Anisotropic part of the strain energy function
F_{t1}	Individual grit tangential micro-grinding forces during the ductile removal phase	W_e	Isotropic part of the strain energy function
F_{t2}	Individual grit tangential micro-grinding forces in the brittle removal stage	W_{iso}	Isotropic part of the strain energy function
F_x	Total micro-grinding force in the x-axis direction in the effective grinding area during one grinding cycle	W_v	Volume part of the strain energy function
F_y	Total micro-grinding force in the y-axis direction in the effective grinding area during one grinding cycle	ε	Strains
$g(t)$	Time-dependent relaxation function	θ	Angles
g_∞	Dimensionless constants	λ	Tension or compression ratio along the loading direction
g_n	Dimensionless constants	v	True strain rate
h_{1a}	Equivalent average depth of cut for the ductile removal stage	v_1	Poisson's ratio of workpiece materials
h_{2a}	Brittle fracture removal equivalent average depth of cut	σ	Linear viscoelastic anisotropic stresses
h_c	Critical cutting depth	$\sigma(\varepsilon,t)$	The stress as a function of strain ε at time t
H_V	Vickers hardness of the material	σ_s	Compressive yield stress in the abrasive contact region
I_1, I_2, I_3, I_4	Strain invariants associated with strain energy functions	τ_i	Relaxation time of the ith Maxwell model
K_{IC}	Static fracture toughness of materials	φ_1	Angle corresponding to the arc length of

			the ductile removal stage in half a grinding cycle
N_1	Effective number of abrasive grains in the ductile removal stage	φ_2	Angle corresponding to the arc length of the abrasive grain in half a grinding cycle
N_2	Effective number of abrasive grains in the brittle removal stage	ANOVA	Analysis of variance