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·综述·

假体周围骨吸收的机制及防治进展

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摘要： 关节置换术目前已经在临床广泛的应用，但是术后10年翻修率达到10%，其主要原因是假体松动。从影像学资料分析，松动假体的周围存在大量的骨质吸收，本文通过对近10年的相关文献的回顾，分析了假体周围骨质吸收的机制以及相应的预防治疗思路。

关键词： 关节；假体；骨质吸收

Progress of the mechanism and the prevention and treatment of bone resorption around the prosthesis *BAO Hangxing, WANG Jinfa, CAI Yunhuo, et al. Zhejiang University of Traditional Chinese Medicine, Hangzhou* 310006, China

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Abstract: Joint replacement surgery is now widely used in the clinic, however the renovation rate exceeds 10% 10 years after the operation. The main reason is the prosthesis loosening. According to the imaging data analysis, there is a lot of bone resorption around the loosening prosthesis. Based on a review of the literature in the past decade, we analyze the mechanism of periprosthetic bone resorption and provide the corresponding preventive treatment ideas.

Key words: Joint; Prosthesis; Bone resorption

关节置换术目前已经在临床广泛的应用，全球每年有100万关节置换，而10年后翻修率达10%[1]。长期跟踪调查显示，术后病人假体生存率达到20年的在80%以上[2]。因此，关节置换术应用于更多年轻以及运动量大的个体中[3]。但是，有大量的因素导致关节置换的远期效果不佳，主要是无菌性骨质吸收、外科手术技术、术后微骨折等。假体周围骨质疏松以及后期的假体松动都和慢性的无菌性炎症相关。对于假体周围骨吸收的原因，近年来，大家比较公认的因素就是假体磨损颗粒，假体的使用寿命往往和磨损颗粒引起的骨质吸收有关[4]，我们搜索了近10年的国内外文献现综述如下。

1 机制研究

关于假体周围骨吸收的机制，是一个复杂的生理病理过程。许多细胞活素不同程度的影响着骨质吸收的过程，如CSF-1、IL-1、TNF-α、IL-6等[2-5]，但是，随着RANK/RANKL路径的发现，以及对它作用机制的研究，对于磨损颗粒引起的假体周围骨吸收的认识，已经得到了长足的发展。破骨细胞分化成熟的过程中，有3个非常重要的因子，即骨保护素(OPG)、细胞核因子kappaB受体活化因子(RANK)、细胞核因子kappaB受体活化因子配基(RANKL)，它们都是肿瘤坏死因子配体和受体家族成员，这，3个因子所形成OPG、RANKL、RANK系统介导了OC形成、分化过程中所必须的细胞间信号传递。当刺激因素作用于成骨细胞(osteoblast, OB)、基质细胞(stromal cell, SC)，诱导其膜上表达RANKL分子，通过与OC前体细胞膜上RANK直接结合，将信号传入前体细胞，引起级联瀑布反应，使OC分化成熟；而OPG则由OB、SC旁分泌发挥作用，竞争性与RANKL结合，封闭RANKL与RANK的结合，将抑制OC的分化、成熟。RANKL是可直接诱导OC分化的细胞因子，其他细胞因子或激素都是直接或间接地通过RANKL与RANK或OPG的相互作用来影响OC分化与成熟的。磨损颗粒，正向调节T淋巴细胞和巨噬细胞，通过RANKL途径，促进破骨细胞的分化[6]，从而引起假体周围骨吸收。

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RANK/RANKL路径是聚乙烯颗粒病的最后一步,但在松动假体周围的假模中分离出了大量增殖的细胞活素,包括TNF-α、IL-1、IL-3、IL-6、TGF-β、PGE2、CSF-1等[7-8]。我们将讨论其中几种的作用机制。

1.1 TNF-α

TNF-α已经被证实是引起聚乙烯磨损颗粒导致骨吸收的一个重要的破骨细胞因子[9-10]。它能够调节其他炎症因子的作用,比如IL-1, IL-6, IL-8, 和GM-CSF等[10-12]。TNF-α能够和RANKL在假体周围骨质吸收中发生协同作用,同时能够独立诱导TNF-α受体NF-κB被激活[13]。Christopher等[14]通过实验证明TNF-α通过激活NF-B从而导致假体周围骨吸收。将11个翻修术病人假体周围骨吸收部位的组织进行病理切片免疫组化,同时对10个初次关节置换病人滑囊组织进行同样处理后发现,翻修组中RANK、RANKL、TNF-α强烈表达,对照组中表达较少。统计学分析后发现,TNF-A和RANKL在引发假体周围骨吸收的过程中有协同作用。

1.2 IL-1(白细胞介素-1)

IL-1是一个炎症前因子,可以引起发热,血管粘附因子的活化,引发关节炎等。IL-1也是通过激活NF-κB从而引发炎症。IL-1是破骨细胞因子促进RANKL的表达,从而导致假体周围骨吸收[15],TNF-α也是通过IL-1作为媒介。IL-1可以直接促进单核破骨细胞前体的增值和分化,但需要RANKL的协同作用[13-15],因此可以理解,IL-1的作用是TNF-α引导的假体周围骨吸收的下游环节,促进RANKL的表达,以及直接激活破骨前体细胞。

1.3 IL-3(白细胞介素-3)

IL-3对OC、OB的分化都具有重要影响。骨髓瘤患者血浆中IL-3比正常水平高,经过研究发现IL-3可加强OC的分化形成[16]。但是,研究也发现IL-3可抑制OC前体的分化过程,它抑制RANKL的NF-kappa信号通路,而且也可通过下调TNF受体来抑制TNF-Dpha对OC的诱导过程,对成熟OC没有抑制作用,IL-3还可间接抑制OB的形成[17]。这些似乎矛盾的研究结果提示IL-3在OC分化成熟的过程中起着复杂的调节作用,以维持骨代谢的平衡。

1.4 IL-6(白细胞介素-6)

IL-6属于gpl30细胞因子家族,多种细胞均可分泌。骨组织中的IL-6主要来源于OB SC分泌,PKG可促使OB表达IL-6[18]。IL-6与IL-3协同支持造血干细胞、OC前体的生长;IL-6也能增强其他细胞因子或激素对OC的作用,如增强PTHrp维持体内钙平衡和调节OC骨吸收的作用。IL-1和TNF-α是具有刺激骨吸收作用的细胞因子,主要是它们能诱导OB产生IL-6,IL-6可与PGE2协同作用通过OPG/RANKURANK系统来调节OC的分化[19]。

1.5 前列腺素(Prostaglandin, PGE)

骨组织中的PGE2主要由OB分泌,是强有力的骨形成和骨吸收刺激因子,对OC的分化具有双重作用,低浓度的PGE2可诱导OC的分化,高浓度的PGE2对分离的OC有抑制作用。PGE2介导多种细胞因子引起的骨吸收[20],研究表明,PGE呈剂量依赖性促进小鼠OB胞内cAMP合成,并通过cAMP-PKA-CREB信号传导途径,促进OB骨基质金属蛋白酶-1(matrixmetalloproteinase-1, MMP-1)与IL-1G基因的表达,促进OB合成和分泌MMP-l与IL-1G,从而有效抑制骨吸收。在RANl(/RANKL,OPG系统的OC分化过程中,PGE与IL-6的相互影响起着重要作用[21]。PGE2还可通过诱导PKC-ERK蛋白激酶信号传导途径中ERK激酶的激活,介导TGF-β促进OB增殖的效应。

尽管大量的炎症因子已经被发现,但是,没有一种被证实在假体周围骨吸收中发挥着决定性的作用。因为在阻断某一个炎症因子后,假体周围的无菌性炎症并没有中断。实验已经证明RANKL-RANK-OPG的相互作用在导致假体周围骨吸收中发挥了关键作用。成骨细胞与破骨细胞之间存在相互调控机制,成骨细胞或骨髓基质细胞表达的核因子-κB受体活化因子配体(receptor activator of NF-kB ligand, RANKL)和巨噬细胞集落刺激因子(macrophage colony stimulating factor, M-CSF)与破骨细胞的形成有关,成骨细胞表面的RANKL与破骨细胞前体细胞表面的RANK结合后,引发一系列反应,促使破骨细胞前体细胞分化和成熟为有功能的破骨细胞,抑制破骨细胞的凋亡。成骨细胞及骨髓基质细胞同时又分泌表达骨保护素(osteoprotegerin, OPG),与RANKL竞争性结合,阻止RANKL与RANK之间的结合,防止骨的过度吸收。因此,RANKL与OPG的比值是维持局部骨代谢平衡的关键。钛离子可能使破骨细胞与成骨细胞之间的联系通讯遭到破坏,直接作用于破骨前体细胞并且使其与成骨衍生因子如M-CSF和RANKL失去联系,或者是破坏了RANK与OPG之间的平衡,从而导致成骨与破骨失调,引起骨质吸收。[22]

2 假体周围骨吸收的治疗和预防思路

2.1 抗 TNF-α 的治疗

TNF-α 在造成假体周围骨吸收的无菌性炎症中所发挥着重要的作用，针对 TNF-α 的治疗是否能够治疗或者缓解假体周围骨质吸收？这个发现为我们的临床治疗提供了一个很好的思路。依那西普是一种 TNF-α 拮抗剂，用于治疗类风湿关节炎。动物实验证明 TNF-α 可以抑制破骨细胞造成的骨吸收[23]。然而一个20个患者组成的临床观察显示，使用依那西普组和安慰剂组在抑制假体周围骨吸收方面没有明显差别[24]。但这只是初步的临床观察，还不足以对依那西普针对假体周围骨吸收的治疗作用做出评估。

2.2 抗炎治疗

假体周围骨吸收是由于无菌性炎症引起的，那么抗炎治疗就必不可少了。这是一种比抗 TNF-α 治疗更为广谱的抗炎治疗，这种广谱的治疗是非常必要的，因为无菌性炎症时一种非常复杂的过程，其机制尚未清楚。Im 等[27]进行的一次体外实验证明，IL-4，IL-10 可以明显抑制 TNF-α 和 IL-6 的表达。然而，目前还没有人体实验的报告。Weiping Ren 等[26]将红霉素进行体外实验证实红霉素可以抑制破骨细胞的产生和分化，从而抑制骨吸收。

2.3 假体材料的改进

选择一种耐磨，并且具备合适强度的假体材料对于假体寿命有着决定性的意义。

从1971年开始，人们开始采用 Al_2O_3 陶瓷替代原有的金属材料，到目前为止已经经历了四代产品。和传统的金属材料相比，Al_2O_3 陶瓷具有高强度和硬度，因此可以减少研磨颗粒的产生，从而提高假体寿命。大量的实验和临床研究也证明了这一点[27]。Donatella Granchi 等[30]的研究表明，Al_2O_3 陶瓷磨损颗粒所引起的破骨细胞分化明显低于高分子聚乙烯颗粒，并且在分子水平证实了这个观点。高分子聚乙烯颗粒改变了人类成骨细胞所释放的溶解因子的结构，促进了破骨前体细胞 c-src 的表达，由此证明聚乙烯颗粒引起破骨细胞的计划和粘附，从而导致骨吸收。相反，Al_2O_3 陶瓷磨损颗粒降低了 c-fos 的表达，说明它降低了巨噬细胞向破骨细胞的分化。Germain 等[29]的体外模拟研磨实验表明，Al_2O_3 陶瓷和聚乙烯的磨损率要低于金属和聚乙烯的磨损率，同时，后者所产生的研磨颗粒的毒性也要高于前者。Urban 等[32]报道 Al_2O_3 陶瓷对聚乙烯的年磨损率为0.034 mm；Hernigou[33]报道 Al_2O_3 陶瓷对聚乙烯的年磨损0.071 mm。

ZrO_2 陶瓷是另一种替代金属的假体材料，和 Al_2O_3 陶瓷相比，它的强度更高，硬度高好，更加不易变形，因此用 ZrO_2 陶瓷设计的髋关节假体，头更小，颈更长，且不会增加再骨折率，但是，临床医生更加愿意选择 Al_2O_3 陶瓷假体[32-34]。因为 ZrO_2 陶瓷假体在10年内的变形率更高，产生更多的研磨颗粒，最终导致假体松动和再骨折。而 Al_2O_3 陶瓷假体的生存率高于 ZrO_2 陶瓷假体，随着材料学的发展，新一代的 Al_2O_3 陶瓷假体将会有更优异的表现。

2.4 中医药治疗

祖国医学博大精深，对于防治假体周围骨质吸收，延长假体寿命，我们可以从中寻求一定的防治思路。假体周围骨吸收，其本质是手术部位局部反应所导致的骨质疏松，因此，可以借鉴已有的中医药治疗骨质疏松的经验，应用于关节置换术后的病人。

2.5 手术技术的注意点

(1)处理髋臼时要尽量增加髋臼底部的深度，从而减少股骨头中心至躯干中线杠杆臂距离，增长股骨头中心至大转子的杠杆臂，达到减轻髋关节假体受力的目的。(2)准备髋臼时，外上缘不要磨锉过多，否则可导致人工髋臼不稳，造成松动。(3)人工髋臼杯置入时，角度要与躯干纵轴45°角。(4)选择的人工股骨头杆柄要与髓腔相匹配，必要时可用髓腔绞刀扩大，以使人工股骨头顺利插入，不致造成股骨近端劈裂。(5) 如人工股骨头柄杆要用骨水泥固定，则骨水泥应均匀包绕在柄杆周围，不要集中在髓腔上部，插入时不要摆动，否则骨水泥轨迹增大，会影响假体的稳定性[35]。

3 总结

假体周围骨质吸收，以及它所带来的假体松动，是影响关节置换术后疗效的关键因素，若能克服这一难题，将会大大提高关节置换术的疗效。目前认为对于假体周围骨吸收主要是磨损颗粒导致的无菌性炎症所导致的，也发现了很多相关的炎症因子，但是最终，最为确定的还是 RANK-RANKL-OPG 途径。目前对于假体周围骨吸收的认识，还不是非常明确，有待我们进一步研究。在明确其机制的基础上，找到治疗的方法。随着材料学的发展，以及手术技术的提高，关节置换术将会得到长足的发展。同时，我们也要积极运用中医药，防治假体周围骨吸收。在多种途径的共同努力下，必将为关节疾病患者带来

更好的生活质量。

[参 考 文 献]

[1] Williams S, Isaac G, Porter N, et al. Long term radiograph assessment of cemented polyethylene acetabular cups. Orthop Relat Res,2008,466(2):366-372.

[2] Mostov K, Werb Z. Journey across the osteoclast. Science, 1997;276: 219-220.

[3] Heisel C, Silva M, Schmalzried TP. Bearing surface options for total hip replacements in young patients. Instr Course Lect, 2004,53:49-65.

[4] Heyworth BE, Shindle MK, Voos JE, et al. Radiologie and intropeative findings in revision hip arthroscopy. Arthmscop, 2007,23(12):1295-1302.

[5] Greenfield EM, Bi Y, Ragab AA, et al. The role of osteoclast differentiation in aseptic loosening. JOrthop Res,2002,20:1-8.

[6] Hallab NJ, Anderson S, Stafford T, et al. Lymphocyte responses in patients with total hip arthroplasty. J Orthop Res,2005, 23: 384-391.

[7] Takei I, Takagi M, Ida H, et al. High macrophage-colony stimulating factor levels in synovial fluid of loose artificial hip joints. J Rheumatol,2000, 27: 894-899.

[8] Xu JW, Li TF, Partsch G, et al. Interleukin-11 (IL-11) in aseptic loosening of total hip replacement (THR). Scand J Rheumatol,1998, 27:363-367.

[9] Blaine TA, Pollice PF, Rosier RN, et al. Modulation of the production of cytokines in titanium-stimulated human peripheral blood monocytes by pharmacologicalagents: the role of cAMP-mediated signaling mechanisms. J Bone Joint Surg Am, 1997, 79:1519-1528.

[10] Clohisy JC, Teitelbaum S, Chen S,et al. Tumor necrosis factor-alpha mediates polymethylmethacrylate particle-induced NF-kappaB activation in osteoclast precursorcells. J Orthop Res, 2002, 20:174-181.

[11] NIH Consensus Development Panel on Total Hip Replacement. Total hip replacement. NIH Consensus Conference. JAMA, 1995, 273: 1950-1956.

[12] Chiba J, Rubash H, Kim KJ, et al. The characterization of cytokines in the interface tissue obtained from failed cementless total hip arthroplasty with and without femoral osteolysis. ClinOrthop Relat Res,1994, 300: 304-312.

[13] Wei S, Kitaura H, Zhou P, et al. IL-1 mediates TNF-induced osteoclastogenesis. J Clin Invest,2005, 115: 282-290.

[14] Merkel KD, Erdmann JM, McHugh KP, et al. Tumor necrosis factor-alpha mediates orthopedic implant osteolysis. Am J Pathol, 1999, 154: 203-210.

[15] Christopher AH, Findlayb DM, Roumen Stamenkovb C, The correlation of RANK, RANKL and TNFa expression with bone loss volume and polyethylene wear debris around hip implants. Biomaterials,27, (2006): 5212-5219.

[16] Zwerina J, Hayer S, Tohidast-Akrad M, et al. Single and combined inhibition of tumor necrosis factor, interleukin-1, and RANKL pathways in tumor necrosis factor-induced arthritis: effects on synovial inflammation, bone erosion, and cartilage destruction. Arthritis Rheum, 2004, 50: 277-290.

[17] Lee JW, Chung HY, Ehrlich LA, et al. IL-3 expression by myelomaceils increases both osteoclast formation and growth of myeloma cells. Blood,2004,103(6):2308-2315.

[18] Khapli SM,Mangashetti LS,Yogesha SD,et al. IL-3 acts directly on osteoclast precursors and irreversibly inhibits rec eptor activator of NF-kappa B ligand-induced osteoc last differentiation by diverting the cells to maemphagelineage. J Immunol,2003, 171(1):142-151.

[19] Yogesha SD, Wani MR. Interleukin-3 and granulocyte-macrophage colony-stimulating factor inhibits tumor necrosis factor(TNF)-alpha-induced osteoclast differentiation by down-regulation of expression of TNF receptors 1 and 2. J Biol Chem, 2005,280(12): 759-769.

[20] Broderick KE, Zhang T, Ranyaswami H, et al. Cyclic GMP/cGMP dependent Protein Kinase Induce Interleukin-6 Transcription in Osteoblasts. Mol Endocrinol,2007,21(5): 148-162.

[21] Liu XH, Kirschenbaum A, Yao S, et al. Interactive effect of interleukin-6 and pmstag landin E2 on osteoclastogenesis via the OPG/RANKL/RANK system. Ann NY Acad Sei,2006,1068: 225-233.

[22] Kim CH, Park YG, Noh SH, et al. PGE2 induces the gene expression of bone matrix metallopmteinase-1 in mouse osteoblasts by cAMP-PKA signaling pathway. Int J Biochem Cell Biol,2005-37:375-385.

[23] Liu XH,Kirschenbaum A. Interactive effect of interleukin-6 and prostaglandin E2 on osteoclastogenesis via the OpG, RANKL, RANK system. Ann NY Acad Se I,2006,1068:225-233.

[24] Boyle WJ, Simonet WS, Lacey DL. Osteoclast differentiation and activation. Nature, 2003;423;337-342.

[25] Childs LM, Goater JJ, O'Keefe RJ, et al. Effect of antitumor necrosis factor-alpha gene therapy on wear debris-induced osteolysis. J Bone Joint Surg Am, 2001, 83:1789-1797.

[26] Schwarz EM, Campbell D, Totterman S, et al. Use of volumetric computerized tomography as a primary outcome measure to evaluate drug efficacy in the prevention of peri-prosthetic osteolysis: a 1-year clinical pilot of etanercept vs. placebo. J Orthop Res,2003, 21:1049-1055.

[27] Im GI, Han JD. Suppressive effects of interleukin-4 and interleukin-10 on the production of proinflammatory cytokines by titanium-alloy particles. J Biomed Mater Res, 2001, 58: 531-536.

[28] Berry DJ, Harmsen WS, Cabanela ME, et al. Twenty-five-year survivorship of two thousand consecutive primary Charnley total hip replacements. J Bone Joint Surg Am,2002,84:171-177.

[29] Jung Yup Lee, Shin-Yoon Kim. Alumina-on-Polyethylene Bearing Surfaces in Total Hip Arthroplasty. The Open Orthopaedics Journal, 2010, 4, 56-60.

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[参 考 文 献]

[1] 曾祥龙. 正畸种植体支抗的发展、类型与应用. 口腔正畸学, 2005, 12(1):44-48.

[2] Misch CE. Bone density: a key determinant for clinical success. Contemporary implant dentistry, St louis: Mosby, 1993: 109-118.

[3] Park HS, Lee YJ, Jeong SH, et al. Density of the alveolar and basal bone of the maxilla and the mandible. Am J Orthod Dentofacial Orthop, 2008, 133(1):30-37.

[4] 李旭鸿, 侯曼, 仰红慧. 骨密度的测定方法及影响因素. 天津体育学院学报, 2005, 20(3):62-65.

[5] 李白艳, 贾文霄, 张鹏, 等. 乌鲁木齐市汉族、维吾尔族正常人群骨密度 DXA 测量. 中国骨质疏松杂志, 2008, 14(7): 486-491.

[6] 李白艳, 张鹏, 贺晓晔, 等. 乌鲁木齐地区汉族健康人群骨密度测量结果分析. 中国骨质疏松杂志, 2006, 12(4):369-372.

[7] Maki K, Okano T, Morohashi T, et al. The application of three-dimensional quantitative computed tomography to the maxillofacial skeleton. Dentomaxillofac Radiol, 1997, 26(1):39-44.

[8] Norton MR, Gamble C. Bone classification: an objective scale of bone density using the computerized tomography scan. Clin Oral Implants Res, 2001, 12(1):79-84.

[9] Shahlaie M, Gantes B, Schulz E, et al. Bone density assessments of dental implant sites: 1. Quantitative computed tomography. Int J Oral Maxillofac Implants, 2003, 18(2):224-231.

[10] Noriharu I, Sadami T. Assessment of Correlation Between Computerized Tomography Values of the Bone and Cutting Torque Values at Implant Placement: A Clinical Study. Int J Oral Maxillofac Implants, 2005, 20(2):253-260.

[11] 周彦恒, 朱胜吉. 口腔正畸种植体支抗的临床应用. 见: 傅民魁, 主编. 口腔正畸专科教程. 北京: 人民卫生出版社, 2007, 499-520.

[12] Park HS. An anatomical study using CT images for the implantation of micro-implant. Korean J Orthod, 2002, 32:435-441.

[13] 朱胜吉, 周彦恒. 成年患者上颌后牙区解剖特点的 CT 研究. 口腔正畸学, 2008, 15(2):53-56.

[14] 梁炜, 林久祥, 徐宝华, 等. 唇、舌侧正畸中上颌中切牙转动中心的研究. 口腔正畸学, 2008, 15(3):121-123.

[15] Lee JS, Park HS, Kyung HM. Micro-implant anchorage for lingual treatment of a skeletal Class Ⅱ malocclusion. J Clin Orthod, 2001, 35:643-647.

[16] Lohr J, Gellrich NC, Buscher P, et al. Comparative in vitro studies of self-boring and self-tapping screws. Histomorphological and physical-technical studies of bone layers. Mund Kiefer Gesichtschir, 2000, 4:159-163.

[17] 朱胜吉, 荣起国, 周彦恒. 微螺钉型种植体支抗长度及直径对应力分布影响的三维有限元研究. 口腔正畸学, 2006, 13(2):49-52.

[18] Hedia HS. Stress and strain distribution behavior in the bone due to the effect of cancellous bone, dental implant material and bone height. Biomed Mater Eng, 2002, 12:111-119.

[19] 吴晶, 白玉兴, 王邦康, 等. 微型种植钉的长度直径对生物力学的影响. 口腔正畸学, 2006, 13(2):53-55.

[20] Skalak R. Biomechanical considerations in osseointegrated prostheses. J Prosthet Dent, 1983, 49(6):843-848.

[21] 龙红月, 林珠, 兰泽栋, 等. 支抗种植体外形对骨界面应力分布的影响. 中国口腔种植学杂志, 2003, 8(2):61-63.

[22] 兰泽栋, 林珠, 龙红月, 等. 支抗种植体不同螺纹顶角对骨界面应力分布的影响. 广东牙病防治, 2003, 11(4):259-261.

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(上接第 165 页)

[30] Donatella Granchi. Molecular basis of osteoclastogenesis induced *by osteoblasts exposed to wear particles. Biomaterials*, 2005, 26: 2371-2379.

[31] Jun g Yup Lee, Shin-Yoon Kim. Alumina-on-Polyethylene Bearing Surfaces in Total Hip Arthroplasty. The Open Orthopaedics Journal, 2010, 4, 56-60.

[32] Urb an JA, Garvin KL, Boese CK, et al. Ceramic-on-polyethylene bearing surfaces in total hip arthroplasty. Seventeen to twenty-one-year results. J Bone Joint Surg Am, 2001; 83-A (11): 1688-1694.

[33] Her nigou P, Bahrami T. Zirconia and alumina ceramics in comparison with stainless-steel heads. Polyethylene wear after a minimum ten-year follow-up. J Bone Joint Surg Br, 2003, 85 (4): 504-509.

[34] Santos EM, Vohra S, Catledge SA, et al. Examination of surface and material properties of explanted zirconia femoral heads. J Arthroplasty, 2004, 19(Suppl 2): 30-34.

[35] Oonishi H, Wakitani S, Murata N, et al. Clinical experience with ceramics in total hip replacement. Clin Orthop Relat Res, 2000, 379: 77-84.

[36] Roberts JA, et al. J Bone Jomt Suxg(Br)1987, 68:345.

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假体周围骨吸收的机制及防治进展

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参考文献(36条)

1. Jun g Yup Lee;Shin-Yoon Kim Alumina-on-Polyethylene Bearing Surfaces in Total Hip Arthroplesty 2010

2. Donatella Granchi Molecular basis of osteoclastogenesis induced by osteoblasts exposed to wear particles 2005

3. Jun g Yup Lee;Shin-Yoon Kim Alumina-on-Polyethylene Bearing Surfaces in Total Hip Arthroplasty 2010

4. Berry DJ;Harmsen WS;Cabanela ME Twenty-five-year survivorship of two thousand consecutive primary Charnley total hip replacements 2002

5. Im GI;Han JD Suppressive effects of interleukin-4 and interleukin-10 on the production of proinflammatory cytokines by titanium-alloy particles 2001

6. Schwarz EM;Campbell D;Totterman S Use of volumetric computerized tomography as a primary outcome measure to evaluate drug efficacy in the prevention of peri-prosthetic astoolysis:a 1-year clinical pilot of etanercept vs.placebo[外文期刊] 2003(6)

7. Roberts JA 查看详情 1987

8. Oonishi H;Wakitani S;Murata N Clinical experience with ceramics in total hip replacement[外文期刊] 2000

9. Santos EM;Vohra S;Catledge SA Examination of surface and material properties of explanted zireonia femoral heads 2004(Suppl 2)

10. Her nigou P;Bahrami T Zirconia and alumina ceramics in comparison with stainless-steel heads.Polyethylene wear after a minimum ten-year follow-up 2003(04)

11. Urb an JA;Garvin KL;Boese CK Ceramic-onpolyethylene bearing surfaces in total hip arthroplasty.Seventeen to twenty-one-year results 2001(11)

12. Childs LM;Goater JJ;O'Keefe RJ Effect of antitumor necrosis factor-alpha gene therapy on wear debris-induced osteolysis 2001

13. Boyle WJ;Simonet WS;Lacey DL Osteoclast differentiation and activation[外文期刊] 2003(6937)

14. Liu XH;Kirschenbaum A Interactive effect of interleukin-6 and prostaglandin E2 on osteoclastogenesis via the OpG,RANKL,RANK system 2006

15. Kim CH;Park YG;Noh SH PGE2 induces the gene expression of bone matrix metallopmteinase-I in mouse osteoblasts by cAMP-PKA signaling pathway 2005

16. Liu XH;Kirschenbaum A;Yao S Interactive effect of interleukin-6 and pmstag landin E2 on osteoclastogenesis via the OPG/RANKL/RANK system 20(0

17. Broderick KE;Zhang T;Ranyaswami H Cyclic GMP/cGMP dependent Protein Kinase Induce Interleukin-

6Transcription in Osteoblasts[外文期刊] 2007(05)

18. Y ogesha SD;Wani MR Interleukin-3 and granulocytemacrophage colony-stimulating factor inhibits tumor necrosis factor(TNF)-alpha-induced osteoclast differentiation by down--regulation of expression of TNF receptors 1 and 2 2005(12)

19. Khapli SM;Mangashetti LS;Yogesha SD IL-3 acts directly on osteoclast precursors and irreversibly inhibits rec eptor activator of NF-kappa B ligand-induced osteoc last differentiation by diverting the cells to maemphagelineage 2003(01)

20. Lee JW;Chung HY;Ehrlich LA IL-3 expression by myelomaceils increases both osteoclast formation and growth of myeloma cells[外文期刊] 2004(06)

21. Zwerina J;Hayer S;Tohidast-Akrad M Single and combined inhibition of tumor necrosis factor,interleukin-1,and RANKL pathways in tumor necrosis factor-induced arthritis:effects on synovial inflammation,bone erosion,and cartilage destruction[外文期刊] 2004(1)

22. Christopher AH;Findlayb DM;Roumen Stamenkovb C The correlation of RANK,RANKL and TNFa expression with bone loss volume and polyethylene wear debris around hip implants 2006

23. Merkel KD;Erdmann JM;McHugh KP Tumor necrosis factor-alpha mediates orthopedic implant osteolysis [外文期刊] 1999

24. Wei S;Kitaura H;Zhou P IL-1 mediates TNF-induced osteoclastogenesis 2005

25. Chiba J;Rubosh H;Kim KJ The characterization of cytokines in the interlace tissue obtained from failed cementless total hip arthroplasty with and without femoral osteolysis 1994

26. NIH Consensus Development Panel on Total Hip Replacement Total hip replacement.NIH Consensus Conference 1995

27. Clohlsy JC;Teitelbaum S;Chen S Tumor necrosis factoralpha mediates polymethylmethacrylate particle-indaced NFkappaB activation in osteoclast precursorcella 2002

28. Blaine TA;Pollice PF;Rosier RN Modulation of the production of cytokines in titanium-stimulated human peripheral blood monocytes by pharmacologicalagents:the role of cAMPmediated signaling mechanisms 1997

29. Xu JW;Li TF;Partsch G Interleukin-11(IL-11)in aseptic loosening of total hip replacement(THR) 1998

30. Takei I;Takagi M;Ida H High macrophage-colony stimulating factor levels in synovial fluid of loose artificial hip joints 2000

31. Hallab N J;Anderson S;Stafford T Lymphocyte responses in patients with total hip arthroplasty[外文期刊] 2005(2)

32. Greenfield EM;Bi Y;Ragnb AA The role of osteoclast differentiation in aseptic loosening 2002

33. Hey worth BE;Shindle MK;Voos JE Radiologie and intraperative findings in revision hip arthroacopy 2007(12)

34. Heisel C;Silva M;Schmalzried TP Bearing surface options for total hip replacements in young patients 2004

35. Mostov K;Werb Z Journey across the osteoclast[外文期刊] 1997(5310)

36.Williams S;Isaac G;Porter N Long term radiograph assessment of cemented polyethylene acetabular cups 2008(02)