REOPERATION EVALUATION AND DEFECTS MECHANISM OF HIP PROSTHESIS

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Abstract: Total hip prosthesis is used in medical praxis already couple of decade. Detrition of artificial joint, especially by hip prosthesis, is a relevant clinical problem. Wearing products of implant induce negative fibre reaction, which can induce sizeable decline of bone in the area around implant and consequently to release of prosthesis fixation. This is the situation for revision. But the revisions are difficult and the reasons are often not good. To betterment of revision results could help research the mechanism of biomechanics and degradation includes wearing.

Introduction

Implantation of metal, ceramic or plastic replacement into human kinetic device can develop many problems. The reasons above all are in failure of connection endoprosthesis stem with femoral bone and connection between implanted socket and pelvis. Additional problems can be induced by deterioration as commodity of the third between cap and socket.

Materials and Methods

General affection of hip joint, that are alternatively led to implantation of total endoprosthesis are:

- primary and secondary osteoarthrosis (76 %),
- reheumatoid arthritis (6 %),
- conditions after fracture of hip joint (11 %).

Spectrum of coxal affections for total endoprosthesis is diverse considering patient age. In the former times patients between the ages of 60 and 75 be treated as the best candidates for implantation of totally endoprosthesis. In last ten years age extent in so far, that today it includes many older patients as well as younger patients. By patients less than 55 years stand in mention alternately surgical procedures how for example fusion or osteotomy.

Patients, which have to undergo totally endoprosthesis implantation, can have following critical factors:

1. Patients weight,
2. Work or patients activities,
3. Senility, mental diseases or alcoholism,
4. Organism sensitivity in foreign bodies.

Revision operations of hip have increasing tendency. The most often reason is the release of implant from joint, which may be caused by deterioration or long-time using.

The constructions of endoprosthesis are similar; differences are in used material and in mode of assessment. Thereof aspect the endoprosthesis divide in two groups:

1. total hip prosthesis, which have the articular planes of one type of material :
   - all-steel,
   - ceramic.
2. combined total hip prosthesis - classical type:
   - steel head, polyethylene joint hole
   - ceramic head in steel neck, polyethylene joint hole.

Total hip endoprosthesis can divide according to mode of prosthesis components fixation and assessment to:

- cemented endoprosthesis,
- non-cemented endoprosthesis,
- hybrid endoprosthesis.

METAL ALLOYS

Requirements for orthopaedic alloys of steels are very serious. These alloys must have the next properties:

- very strong – they can not break, infract or bent until sizeable load,
- not very hard – too hard material will to prejudice the bone with tension effect,
- biocompatibility – they must be good tolerated in organism

All steel alloys used in production of orthopaedic implants are stiffed crystal solutions. All of them are first moulted and then they will let cool down in forms. During feeding the alloy crystallize and partly contract. Orthopaedic alloys dividing in cobalt - crome, titan and special rust resist steels.

POLYETHYLEN

Polyethylene is the simple polymer, organically compound characterized with long reduplicate molecules. Mechanical properties of polyethylene can be castigated with increasing of molecule mass. This material is called UHMWPE (ultra-high-molecular-weight polyethylene). They biggest facility is the low sliding friction. The new products are gas sterilized UHMWPE and each other cross-linked UHMWPE - the long molecules are linked with radiation help.

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Among the basic properties belong high resistance for abrasion, low coefficient of friction, high impulse stronghold, very good toughness, easy treatment, biocompatibility and biostability in human organism.

CERAMICAL MATERIALS

Ceramic materials are stiff materials consisted only of simple aluminium oxide or zircon crystals. The ceramics are very sturdy, most chemical and biological inert. Thereat is the ceramic very sturdy toward chafages and splits. The ceramic have good resistance for attrition, attraction of liquids, thereat they have low friction.

BONE CEMENT

They consist of 90% polymetylmetacrylat (PMMK), rest of them is largely crystallise barium sulphate. It is used to fixation of artificial joint to bone base. It is not glue, it work as binding material.

Disadvantages of bone cement is mechanical wearing because of scum's like air and blood, fragility, tendency to brittle failure, little minims of cement involve osteolysis and they surface is very big, what support colonization of bacterium. Advantages are very good linking properties, possibility using directly by doctor and the operation technique with bone cement is more likely.

Results

The reoperation database of hip.

The source of dates for database was creatied from medical records and operative reports of patients on Orthopaedic department of Teaching hospital in Prešov.

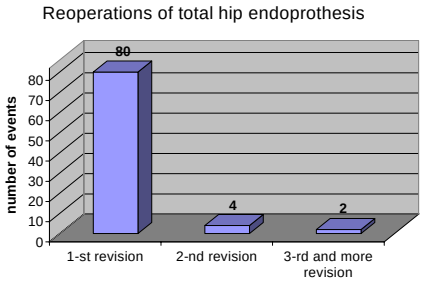

Figure 1: Reoperations in term of number of revisions. The results are correlate with all conventional statistics.

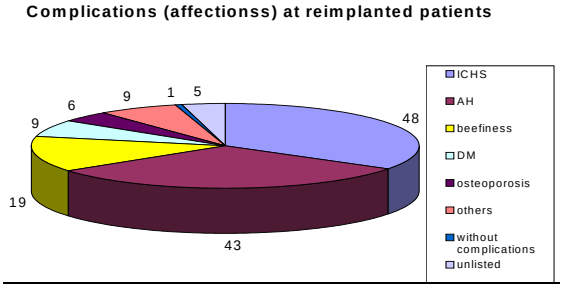

Figure 2: Appearance of complications (affections) at reimplanted patients. The most oftens affections (ICHS - ischaemic affection of heart, Ah -arterial hypertension). The results are not per capita, but per number of appearance. One patient can have the combination of affections.

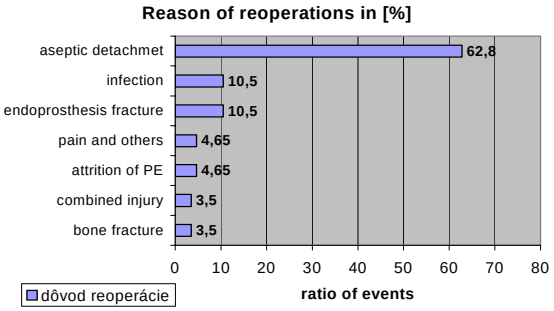

Figure 3: Reasons for reoperations. Comparison with Sweden (2000): Attrition in Sweden in only 0,50%.

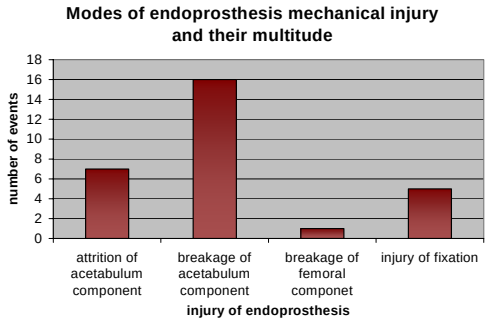

Figure 4: Mechanical injuries of endoprosthesis.

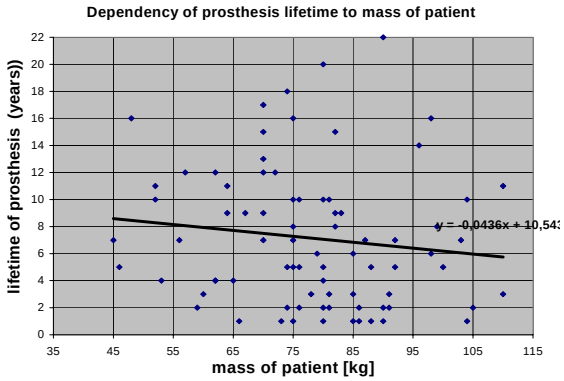

Figure 5: Lifetime of endoprosthesis - mass of patient. The lifetime with mass increasing decrease, but the dependency is not very strong, because on the prosthesis affects more others factors.

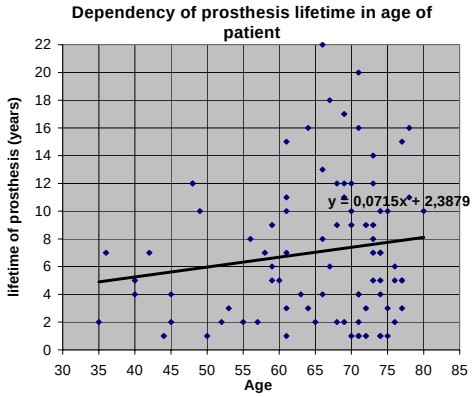

Figure 6: Dependency of prosthesis lifetime in age of patient. The lifetime of prosthesis increase with age, because the young peoples live more actively.

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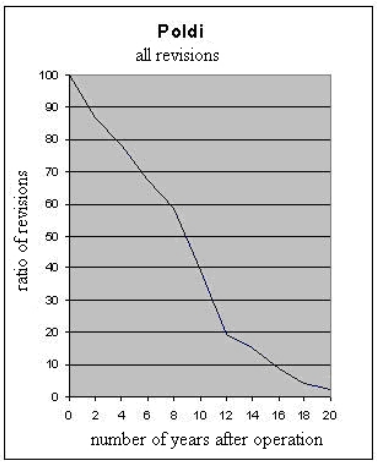

Figure 7: Poldi – Analysis of endoprosthesis lifetime, which show expectation of function failure because of any reasons. Approximately 9 years after operation work trouble free only 50% of POLDI implanted endoprosthesis.

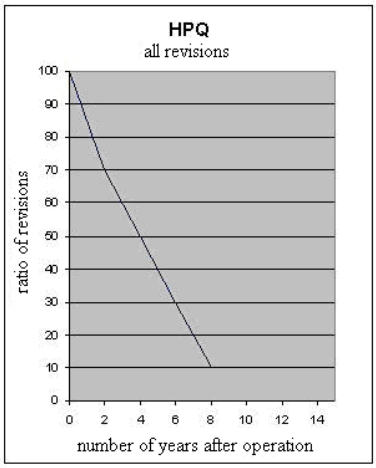

Figure 8: HPQ (hole) – Analysis of endoprosthesis lifetime. The curve is relatively steep, it indicate the early requirement of revision. Already 4 years after operation work trouble free only 50% of HPQ implanted holes.

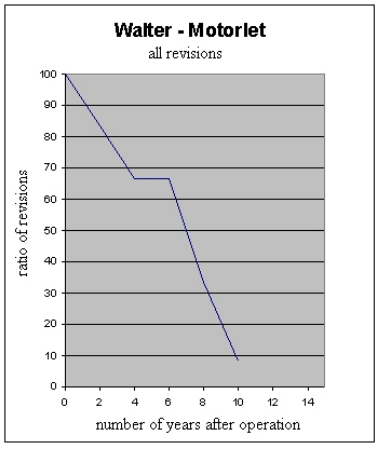

Figure 9: Walter-Motorlet – Analysis of endoprosthesis lifetime. The curves indicate the good stage of this endoprosthesis type. Approximately 7 years after operation work trouble free only 50% of W-M implanted endoprosthesis.

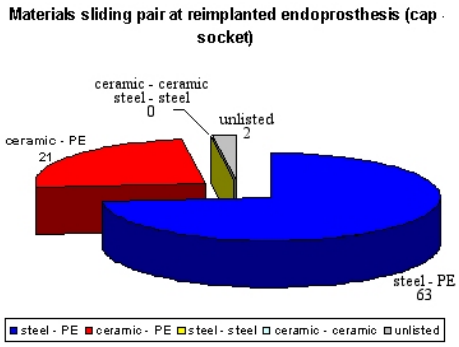

Figure 10: Materials sliding pair at reimplanted endoprosthesis (cap - socket). Mostly was used the combination of steel - UHMWPE (73.3 %) or ceramic - UHMWPE (24,4%).

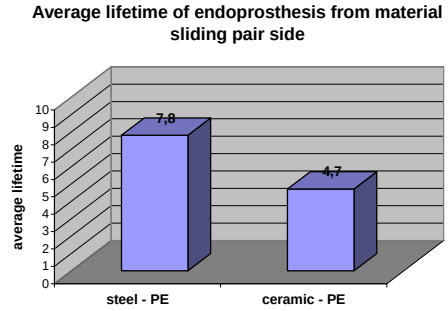

Figure 11: Average lifetime of endoprosthesis from material sliding pair sides. Ceramic - ceramic, steel - steel sliding pairs was not used, because the price is too high.

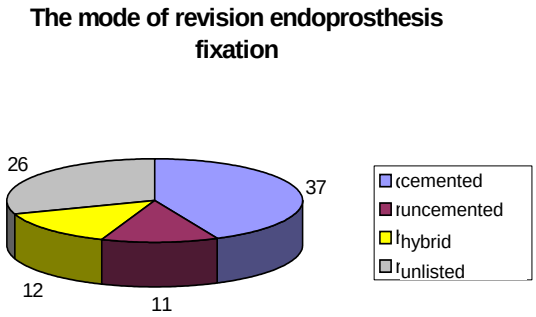

Figure 12: The mode of revision endoprosthesis fixation. The results may be biased, because in 26 events is not known the mode of fixation. Comparison with Sweden register: The results corresponded with this analyse.

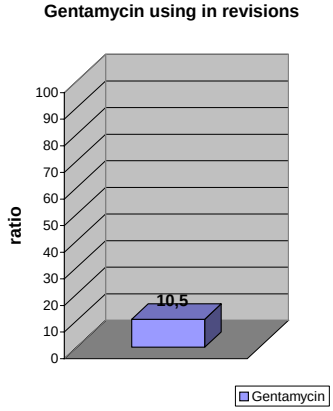

Figure 13: Gentamycin using in revisions.

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From the request of praxis were formulated two basics preferences:

- creation and statistical evaluation of implanted and reimplanted patients database,
- projection and evaluation of database product, which will serve as resource to evidence of patient with possibility to add and complementing the database with new records.

Presented results are the objectives of grant work VEGA 1/2191/05 – Monitoring of the rehabilitation process in paraplegics and quadriplegics in the vertical plane by IR – thermography utilization.

References

[1] BEZNOSKA, S., ČECH, O., LOBL, K.: Umelé náhrady ľudských kĺbov, SNTL, Praha, 1987

[2] KONVIČKOVÁ, S., VALENTA, J.: Biomechanika kĺbov človeka a ich náhrady, Praha, 2000

[3] MICHALÍKOVÁ, M.: Diplomová práca Návrh antiagesívnych metodík v procese implantológie, TUKE SjF KPaBI, 2003

[4] SOSNA, A., POKORNÝ, D., JAHODA, D.: Endoprotéza kyčelního kloubu, Triton, Praha, 1999.

[5] ŽIVČÁK J., HUDÁK R., KĽOC J., MICHALÍKOVÁ M., TÓTH T.: Základy bioniky a biomechaniky, ManaCon, Prešov, 2004, ISBN 80-89040-25-X

[6] KĽOC, J. – chorobopisy reimplantácií 1993 – 2004, ortopedické oddelenie FNsP Prešov

[7] http://www.linkorthopaedics.com/main.html

[8] http://www.orthes.cz

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