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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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HOW TO AVOID FRACTURE OF THE LOCKING SCREW IN MODULAR REVISION ARTHROPLASTY OF THE HIP USING THE MRP TITAN REVISION SYSTEM

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Abstract.

Introduction: The use of modular femoral stems in primary and revision arthroplasty of the hip has become popular within the last decade. On the other hand, modularity creates new potential problems like fretting, crevice and galvanic corrosion, component loosening, dissociation, and fracture of modular prostheses. Recently a problem of fracture of a locking screw in revision arthroplasty of the hip using the MRP Titan Stem (Peter Brehm GmbH, Weisendorf, 91085 Germany) appeared. The aim of this study is to evaluate the meaning of surface contamination in respect to fracture mechanism.

Material and Methods: The titanium nitrid coated locking screw M6 of the MRP Titan system was in vitro tested in several series. After experimental contamination (series 1-4) morse taper junction was fixed by the locking screw with a torque wrench:

Series 1: The influence of contamination with dried blood was examined while screw M6 was put into pig's blood.

Series 2: The influence of contamination with dried blood and biologic tissue was examined while screw M6 was covered with a pulpous mixture of pig's blood, pig's muscle, and pig's fat tissue.

Series 3: The influence of contamination with dried blood and biologic tissue was examined while female thread was covered with a pulpous mixture of pig's blood, pig's muscle, and pig's fat tissue.

Series 4: The influence of cleaning of the contaminated female component was examined while female thread contamination (with a pulpous mixture of pig's blood, pig's muscle, and pig's fat tissue) was cleaned with 50 ml saline solution.

Results: Comparing series 1 with series 4, series 2 with series 4 and series 3 with series 4 statistical analysis showed a significant reduction of fractures of screw M6 (p-values <0.01).

Conclusion: To avoid fracture of the screw M6 of the MRP Titan System we recommend cleaning the inner thread of the morse taper junction with saline solution before junction is fixed with the screw and the torque wrench.

Key words. MRP Titan, fracture, hip, modular stem, locking screw.

Introduction.

The use of modular femoral stems in primary and revision arthroplasty of the hip has become popular within the last decade because of the advantage of more flexibility and optimization of femoral anteversion, limb length, and femoral component offset. In several studies good mid- to long- term results have been published for the MRP Titan Revision Stem in revision arthroplasty of the hip [1-4]. Modularity also provides intraoperative flexibility when partial hip implant revision is required. On the other hand, modularity creates new potential problems and complications which should be taken into account. Micromovement, component loosening, Fretting, crevice and galvanic corrosion, fracture, and dissociation of modular prostheses in primary and revision hip arthroplasty have been published [5-17].

Recently a recurrent fracture of the cone of the morse taper junction of the MRP Stem in an obese Patient has been published [15]. In this case intraoperatively a fractured locking screw could be found.

Grupp et al. [16] postulated surface contamination as a risk factor for modular titanium alloy neck adapter failures in hip replacement.

The aim of this study was to evaluate the meaning of surface contamination in respect to fracture of the locking screw of the MRP Titan Revision System (Peter Brehm GmbH, Weisendorf, Germany).

Materials and Methods.

The modular MRP Titan Revision System (Peter Brehm GmbH, Weisendorf, 91085 Germany) (Figure 1) based on modular taper connections designed for cementless implantation with initial distal diaphyseal fixation. The implant components are made of a titanium alloy (Ti6Al4V) with a rough corundum-blasted surface with a roughness of 40-60 μm to facilitate osseous integration. The modular design essentially consists of three components:

Figure 1. *The MRP-TITAN System with the locking screw (gold).*

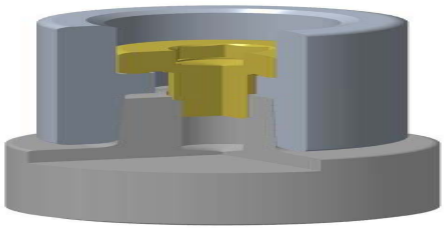
– The distally tapered femoral stem with longitudinal parabolic ribs for fixation with rotational stability. The stem is available as a straight-stem model in 140 mm and 200 mm length and curved-stem version to fit the physiologic anterior bow of the femur in 200 mm length. 260 mm and 320 mm curved stems with two distal transverse drill holes are also available, providing the possibility to use distal locking bolts for additional stability. Diameters are available in 1 mm increments between 13 and 22 mm.

– Three different neck models (length 50, 60, and 70 mm) with a standard taper (Euro taper 12/14). The neck components are available with different neck-stem angles of 130° (37 mm offset) and 123° (47 mm offset).

– An optional extension sleeve, adding 30 mm to the neck length. The continuously adjustable taper connections are locked intraoperatively with a titanium-nitride coated locking screw using an implant-specific torque wrench 25 Nm.

The locking screw M6 (Figure 2) is made from Ti6Al4V alloy according to ASTM and DIN ISO [18-21]. The screw is 25 mm long, whereas the screw shaft measures 17 mm, thread length is 12 mm with 12 threads. The screw is titanium-nitride coated to reduce sliding friction [22]. During the fixation process titanium-nitride coating shows smooth abrasion.

Figure 2. *Sectional view through the test specimen.*



To evaluate the influence of contamination the inner tread of the morse taper junction in respect to fracture of the titanium nitrid coated locking screw M6 of the MRP Titan system was in vitro tested.

An MRP-stem model with the male component of the morse taper junction was fixed in a jaw vice. The model stems and necks were assembled and fixed with the locking screw using the original implant devices. In sum 134 screws, model stems and model necks were tested. The taper connections were locked using the implant-specific torque wrench of minimum 25 Nm.

To investigate the influence of NaCl solution on fixing the locking screw a preliminary study was conducted (series 0) (Table 1).

Table 1. *Different trials with different sample sizes.*

Trial	Sample size	Contamination	Time of initial drying
0	40	sodium chloride solution	-
1	14	Contamination of the screw with blood	60-90 min
2	40	Contamination of the screw with blood and soft tissue (muscle and fat tissue)	60-90 min
3	20	Contamination of the female thread with blood and soft tissue (muscle and fat tissue)	60-90 min
4	20	Contamination of the female thread with blood and soft tissue (muscle and fat tissue) and cleaning after drying	60-90 min

Series 1:

The influence of contamination with dried blood was examined as the components of the MRP TITAN stem get in contact with patients` blood intraoperatively, therefore the screw M6 was put into pig's blood. After blood drying the morse taper junction was fixed with the torque wrench.

Series 2:

The influence of contamination with dried blood and biologic tissue was examined as the components of the MRP TITAN stem get in contact with patients´ blood and soft tissue (e.g., fat, muscle tissue) intraoperatively. Therefore, the screw M6 was covered with a pulpous mixture of pig's blood, pig's muscle, and pig's fat tissue. After the drying process the morse taper junction was fixed with the torque wrench.

Series 3:

The influence of contamination with dried blood and biologic tissue was examined as the components of the MRP TITAN stem get in contact with patients` blood and soft tissue (e.g., fat, muscle tissue) intraoperatively. Therefore, the female thread component was covered with a pulpous mixture of pig's blood, pig's muscle, and pig's fat tissue. After the drying process of the female thread component a new clean M6 screw was taken out of the sterile wrapping and fixed with the torque wrench.

Series 4:

The influence of cleaning of the contaminated female thread component was examined. Therefore, the female thread component was covered with a pulpous mixture of pig's blood, pig's muscle, and pig's fat tissue. After the drying process of the female thread component the contamination was cleaned with 50 ml saline solution. Afterwards a new clean M6 screw was taken out of the sterile wrapping and fixed with the torque wrench.

For our in vitro study we selected a long drying phase to be sure that the drying process at 20°C was complete, knowing that intraoperatively drying process is much more faster due to manipulation of the prosthesis devices and laminar air flow.

Aim is to analyse the differences of fracture of the screw M6 (Figure 3) in different settings (series 1-4). Due to the small sample numbers, we selected Fisher's exact test for statistical analysis [23,24]. Since there is the reasonable assumption that cleaning the interface reduces the probability of screw cracks, we use the one-sided variant of the test.

After pretesting we performed a power analysis, which led to different sample sizes in series 1 to 4.

Figure 3. *Torsion fracture of screw M6.*

Results.

Table 2:

In series 1 more power was necessary to fix screw M6 using the torque wrench.

Table 2. *Tabular summary of the results.*

Series	**1**	**2**	**3**	**4**
Sample size	14	40	20	20
Number of fractures	5	18	7	0
Location of fracture (No. of thread)	8-9	8-9	8-9	-
Fracture type	torsion fracture	torsion fracture	torsion fracture	-
Sound during fixing screw M6 using torque wrench	Creaking	Creaking	Creaking	Squeaking

After removal of the fractured screw blood could be found within the female thread component.

In series 2 more power was necessary to fix screw M6 using the torque wrench, too. After removal of the fractured screw dried coagulum could be found within the female tread. In some cases, the complete screw could be removed. In these cases, all threads showed contamination.

In series 3 fixing of screw M6 was quite easy as contamination focused on the female component. After removal of the fractured screw dried coagulum could be found within the female thread.

In series 4 the female thread of the morse taper junction was cleaned after contamination. Due to the cleaning process with saline solution coagulum (up to 5 mm diameter) could be removed. Inspection revealed that no complete cleaning could be achieved.

Comparing series 1 with series 4, series 2 with series 4 and series 3 with series 4 statistical analysis showed a significant reduction of fractures of screw M6. For H0: $p1 \leq p4$, H0: $p2 \leq p4$ and H0: $p3 \leq p4$ the p-values are 0.0072, 0.0001 and 0.0042 respectively.

Cleaning of contaminated female thread of the morse taper junction leads to a significant reduction of fractures of locking screw M6 of the MRP TITAN System. In cases of cleaned components, no fracture of the screw could be detected.

In cases of fractured screws removal of the distal part of the broken screw was easy possible. Analyzing surface of titanium-nitride coated screws surface of the screws showed no signs of abrasion of titanium-nitride coat.

Discussion.

Grupp et al. [16] were the first who showed that surface contamination with blood or biologic tissue is a risk factor for breakage of modular components in total hip replacement. Failure of modular titanium alloy neck adapters can be initiated by surface micromotions due to surface contamination or highly loaded implant components [16]. Another risk factor for implant failure is body weight over 100 kg which is postulated by Schuh et al., too [15]. Grupp et al. [16] recommended the use of modular cobalt chrome neck adapters which should provide higher safety compared to Titanium alloy material. Haschke H et al. [25] postulated that surgeons should carefully use assembly forces above 4 kN to decrease the amount of relative motion within the taper interface of neck adapters made of titanium (Ti6Al4V) and CoCr (CoCr29Mo).

In respect to published allergic reactions against cobalt chrome alloys [26-29] and the possible problem of local galvanic element mixing titanium and cobalt chrome alloys we don't follow this solution.

Our results clearly show that contamination of the inner tread of morse taper junction with blood or other biologic tissue leads to a significant reduction of resistance against fracture of the screw M6. Contamination can occur if the guiding rod has to be fixed several times and gets in contact with intraoperativ situ. This leads to contamination of the guiding rod and the female component of the threads. Contamination leads to blocking of the screw. If fixation process of screw M6 is continued forcely using torque limiter the screw can be twisted off. In cases of fractured screws removal of the distal part of the broken screw was easy possible as blocking of the screw seems to occur in just one direction. Normally the fixation process of the titanium-nitride coated screw M6 leads to smooth abrasion of the coating as a sign of complete contact of screw with the neck. In our study no or few signs of abrasion could be detected in contaminated screws. We conclude that in cases of contamination the head of the screw does not get in contact with the neck. In that way the torsional moment of 25 Nm concentrates on the body of the screw and leads to fracture of the screw. The screw is designed to resist tensile stress not torsional stress.

Conclusion.

Modularity in THR provides intraoperative flexibility when partial hip implant revision is required. However, modularity creates new potential problems and complications like fretting, crevice and galvanic corrosion, component loosening and fracture. To avoid fracture of the screw M6 in revision arthroplasty of the hip using the MRP Titan System we recommend cleaning the inner tread of the morse taper junction with saline solution.

Conflict of interest statement.

The author declares no conflict of interest.

REFERENCES

1. Hoberg M, Konrads C, Engelien J, et al. Outcome of a modular tapered uncemented titanium femoral stem in revision hip arthroplasty. Int Orthop. 2015;39:1709-1713.
2. Schuh A, Werber S, Holzwarth U, et al. Cementless modular hip revision arthroplasty using the MRP Titan Revision Stem: outcome of 79 hips after an average of 4 years' follow-up. Arch Orthop Trauma Surg. 2004;124:306-309.
3. Wimmer MD, Randau TM, Deml MC, et al. Impaction grafting in the femur in cementless modular revision total hip arthroplasty: a descriptive outcome analysis of 243 cases with

the MRP-TITAN revision implant. BMC Musculoskelet Disord. 2013;14:19.
4. Wirtz DC, Gravius S, Ascherl R, et al. Uncemented femoral revision arthroplasty using a modular tapered, fluted titanium stem: 5- to 16-year results of 163 cases. Acta Orthop. 2014;85:562-569.
5. Atwood SA, Patten EW, Bozic KJ, et al. Corrosion-induced fracture of a double-modular hip prosthesis: a case report. J Bone Joint Surg. 2010;6:1522-1525.
6. Dangles CJ, Altstetter CJ. Failure of the modular neck in a total hip arthroplasty. J Arthroplasty. 2010;25:1169.e5-7.
7. Dunbar MJ. The proximal modular neck in THA: a bridge too far: affirms. Orthopedics. 2010;33:640.
8. Duncan ST, Hayes CB, Nunley RM. Fracture at the Modular Junction of a Cementless Revision Hip System: A Case Report. JBJS Case Connect. 2016;6:e48.
9. Ellman MB, Levine BR. Fracture of the modular femoral neck component in total hip arthroplasty. J Arthroplasty. 2013;28:196.e1-5.
10. Esposito CI, Wright TM, Goodman SB, et al. Clinical, Biological and Bioengineering Study Groups from Carl T. Brighton Workshop. What is the trouble with trunnions? Clin Orthop Relat Res. 2014;472:3652-3658.
11. Lakstein D, Eliaz N, Levi O, et al. Fracture of cementless femoral stems at the mid-stem junction in modular revision hip arthroplasty systems. J Bone Joint Surg. 2011;93:57-65.
12. Munir S, Walter WL, Walsh WR. Variations in the trunnion surface topography between different commercially available hip replacement stems. J Orthop Res. 2015;33:98-105.
13. Parisi T, Burroughs B, Kwon YM. Modular hip implant fracture at the stem-sleeve interface. Orthopedics. 2015;38:e234-239.
14. Pour AE, Borden R, Murayama T, et al. High Risk of Failure with Bimodular Femoral Components in THA. Clin Orthop Relat Res. 2016;474:146-153.
15. Schuh A, Sesselmann S, Scheller A, et al. Recurrent Fracture of the Cone of a Morse Taper Junction of the MRP Stem in an Obese Patient- A Case Report. J Med Adv Clin Case Rep. 2020;1:1-4.
16. Grupp TM, Weik T, Bloemer W, et al. Modular titanium alloy neck adapter failures in hip replacement-failure mode analysis and influence of implant material. BMC Musculoskelet Disord. 2010;11:3.
17. Fink B. What Can the Surgeon Do to Reduce the Risk of Junction Breakage in Modular Revision Stems? Arthroplast Today. 2018;4:306-309.
18. ASTM F136-13: Standard Specification for Wrought Titanium-6Aluminum-4 Vanadium ELI (Extra Low Interstitial) Alloy for Surgical Implant Applications (UNS S56401).
19. ISO 5832-3:2017-03. Implants for surgery - Metallic materials - Part 3: Wrought titanium 6-aluminium 4-vanadium alloy (ISO 5832-3:2016).
20. ISO 7206-6:2013-11. Implants for surgery - Partial and total hip joint prostheses – Part 6: Endurance properties testing and performance requirements of neck region of stemmed femoral components.
21. ISO 7206-4:2010-06. Implants for surgery - Partial and total hip joint prostheses – Part 4: Determination of endurance properties and performance of stemmed femoral components.
22. van Hove RP, Sierevelt IN, van Royen BJ, et al. Titanium-Nitride Coating of Orthopaedic Implants: A Review of the Literature. Biomed Res Int. 2015;2015:485975.
23. Pfanzagl J. Allgemeine Methodenlehre der Statistik, Band II, 3. Auflage, Berlin 1968.
24. Bortz J, Lienert GA, Boehnke K. Verteilungsfreie Methoden in der Biostatistik. 3. Auflage. Berlin Heidelberg 2008.
25. Haschke H, Jauch-Matt SY, Sellenschloh K, et al. Assembly force and taper angle difference influence the relative motion at the stem-neck interface of bi-modular hip prostheses. Proc Inst Mech Eng H. 2016;230:690-699.
26. D'Angelo F, Tanas D, Gallazzi E, et al. Adverse reaction to metal debris after small-head diameter metal-on-metal total hip arthroplasty: an increasing concern. Hip Int. 2018;28:35-42.
27. Thomas P, Weik T, Roider G, et al. Influence of Surface Coating on Metal Ion Release: Evaluation in Patients with Metal Allergy. Orthopedics. 2016;39:24-30.
28. Hopf F, Thomas P, Sesselmann S, et al. CD3+ lymphocytosis in the peri-implant membrane of 222 loosened joint endoprostheses depends on the tribological pairing. Acta Orthop. 2017;88:642-648.
29. Krüger D, Günther KP, Deml M, et al. Mechanical failure of 113 uncemented modular revision femoral components risk factors for fracture and failure with a case control comparison analysis. Bone and Joint Journal. 202;102-B:573-579.