



## УНИВЕРЗИТЕТ У БЕОГРАДУ

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На основу члана 47. став 5. тачка. 3. Статута Универзитета у Београду ("Гласник Универзитета у Београду", број 162/11- пречишћени текст, 167/12 и 172/13) и чл. 14. – 21. Правилника о већима научних области на Универзитету у Београду ("Гласник Универзитета у Београду", број 134/07, 150/09, 158/11, 164/11 и 165/11), а на захтев Стоматолошког факултета, број: 2464/1 од 17.12.2013. године,

Веће научних области медицинских наука, на II седници одржаној 18.2.2014. године, донело је

### ОДЛУКУ

**ДАЈЕ СЕ** сагласност на предлог теме докторске дисертације:

Кандидат:

Др Хатаб Нур

Назив теме: „Утицај промена горњих ваздушних путева на квалитет живота пацијената после хируршке корекције деформитета III скелетне класе“.

Председник Већа

Проф. др Весна Спасојевић-Калимановска



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- Факултету,
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УНИВЕРЗИТЕТ У БЕОГРАДУ  
СТОМАТОЛОШКИ ФАКУЛТЕТ  
СЕКРЕТАРИЈАТ

ПРИМЉЕНО: 28-02-2014

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## **NASTAVNO-NAUČNOM VEĆU STOMATOLOŠKOG FAKULTETA U BEOGRADU**

Odlukom Nastavno-naučnog veća Stomatološkog fakulteta u Beogradu, donetom na I redovnoj sednici u školskoj 2015/2016. godini, održanoj 20.10.2015. godine, imenovani smo u komisiju za ocenu završene doktorske disertacije dr Nur Hatab pod nazivom **UTICAJ PROMENA GORNJIH VAZDUŠNIH PUTEVA NA KVALITET ŽIVOTA PACIJENATA POSLE HIRURŠKE KOREKCIJE DEFORMITETA III SKELETNE KLASE**. Izabrana komisija je u sastavu:

- Doc. dr Milan Petrović
- Prof. dr Predrag Nikolić
- Prof. dr Dragan Krasić, Med. Fak. Stomatološki odsek, Univerzitet u Nišu

Na osnovu analize rada kandidata na doktorskim studijama i priloženog rukopisa doktorske disertacije, Komisija podnosi Nastavno-naučnom veću sledeći

### **IZVEŠTAJ**

#### **1. Biografski podaci kandidata**

Dr Nur Hatab rođena je 6.3.1989. u Nišu gde je završila osnovnu školu i gimnaziju. Medicinski fakultet Univerziteta u Nišu smer Stomatologija upisala je 2007. godine, a diplomirala 2012. godine sa prosečnom ocenom 9,35, kao prva u generaciji. U toku studija bila je stipendista Ministarstva prosvete Republike Srbije i stipendista grada Niša. Obavezni lekarski staž završila je 2013. godine, kada je položila stručni ispit za doktora stomatologije. Doktorske studije na Stomatološkom fakultetu Univerziteta u Beogradu upisala je školske 2012/2013. godine. Položila je sve ispite predviđene nastavnim planom i programom doktorskih studija školske 2013/2014. godine. Nastavno-naučno veće

Stomatološkog fakulteta je 2013. godine donelo odluku o usvajanju predloga teme doktorske disertacije. Za vreme doktorskih studija bila je stipendista Ministarstva Nauke Republike Srbije za rad na projektima ministarstva.

Dr Nur Hatab objavila je 9 naučnih radova od kojih su dva u časopisu na SCI listi:

Nada Vujasinovic Stupar, Slavica Pavlov-Dolijanovic, **Nur Hatab**, Bojan Banko, Milan Djukic, Natasa Nikolic Jakoba. Multiple Major and Minor Anomalies Associated With Klippel-Feil Syndrome: A Case Report. Arch Rheumatol. 31(x):i-v, 2016

**N.A. Hatab** , V.S. Konstantinovic , J.K.H. Mudrak. Pharyngeal airway changes after mono- and bimaxillary surgery in skeletal class III patients: Cone-beam computed tomography evaluation. J Craniomaxillofac Surg. 43: 491-496, 2015

**Nur Hatab**, Vitomir Konstantinović, Jörg Mudrak. Using CBCT in implant restoration of auricular defect. Soredex case study, 2015.

**Nur Hatab**, Vitomir Konstantinović, Jörg Mudrak. The Paget's disease. Soredex case study, June 2015.

**Nur Hatab**, Jörg Mudrak, Vitomir Konstantinović, Evaluation of a Bilateral Condyle Fracture by CBCT. Dentomaxillofacial Soredex case study, Spring 2014.

**Nur Hatab**, Vitomir Konstantinovic. Using CBCT in Diagnosis and Evaluation of Le Fort Fractures. Soredex Medical Case Report Booklet DMFR & ENT, Spring 2014. Page 12-18.

**Nur Hatab**, Jörg Mudrak, Vitomir Konstantinović . Use of 3-Dimensional Cephalometric Analysis in Planning and Evaluation of Orthognathic Surgery. Dentomaxillofacial Soredex case study, winter 2014.

**Nur Hatab**, Vitomir Konstantinović, Zoran Jezdić, Neda Stefanović, Drago Jelovac. 3D evaluation of pharyngeal airway narrowing after orthognathic surgery: a case report. Dentomaxillofacial Case Report Booklet, Winter 2014. Page 14-17.

**Hatab N**, Mudrak J, Drago J, Konstantinović V, Comparison of pharyngeal airway dimensions and sagittal position of the upper and lower jaw in class III patients. DI Europe. 2013; 29(7): 42-43.

Učestvovala je na domaćim i međunarodnim kongresima gde je prezentovala 9 naučnih radova:

**Nur Hatab**, Biljana Milicic, Jorg Mudrak, Vitomir Konstantinovic. Effect of mono- and bimaxillary surgery, in skeletal class III patients on pharyngeal airway volume using CBCT evaluation. XXII Congress of the European Association for Cranio-Maxillo-Facial Surgery. Prague, Czech Republic.

**Nur Hatab**, Vitomir Konstantinovic. 3D evaluation of cephalometric changes, after mono and bi maxillary class III orthognathic surgery. 3<sup>rd</sup> Balkan congress of OMFS, Ohrid, Macedonia. April 2014

**Nur Hatab**, Zoran Jezdić, Drago Jelovac, Neda Stefanović, Vitomir Konstantinović. 'Evaluation of three-dimensional changes in the upper airway after surgical correction of Class III deformity'. 14<sup>th</sup> Congress of Serbian association of maxillofacial surgeons, with international participation and 3rd Conference of Balkan association of maxillofacial surgeons, Niš. November 2013.

**Hatab N**, Drago J, Jezdić Z, Mudrak J, Stefanović N, Konstantinović V. Measuring the pharyngeal airway in 3 dimensions: a preliminary study. Int. J. Oral Maxillofac. Surg. 2013; 42 (10): 1260

**Nur Hatab**. "Analysis of complications following the surgical removal of impacted wisdom teeth"("Analiza komplikacija nakon hirurškog vađenja impaktiranog umnjaka"), 23<sup>rd</sup> EUROPEAN STUDENTS' CONFERENCE, septembar 2012. (Abstract Book 2011, strana 75);

**Nur Hatab**, Martina Rakonjac, Milan Kulic „Efikasnost primene hijaluronske kiseline u tretmanu mehaničkih oštećenja usne duplje“, 53. Kongres studenata Biomedicinskih nauka Srbije , April 2012. (Knjiga sažetaka strana 398);

**Nur Hatab**. "Tumori pljuvačnih žlezda u Niškom regionu: retrospektivna analiza 142 slučaja“, 53. Kongres studenata Biomedicinskih nauka Srbije , April 2012. (Knjiga sažetaka strana 408);

**Nur Hatab**. „Application of skin transplantation in oncological surgery“ („Primena transplantanata kože u onkološkoj hirurgiji“), Internacional Medical Students' Congress in Novi Sad, Jul 2011. (Abstract Book 2011, strana 209);

**Nur Hatab.** „Procena postoperativnog analgetičkog dejstva bupivakaina u hirurgiji periapikalnih lezija“, 52. Kongres studenata Biomedicinskih nauka Srbije , April 2011. (Knjiga sažetaka strana 162);

## **2. Naučna oblast i fizički opis rada**

Doktorska disertacija dr Nur Hatab pod naslovom "**UTICAJ PROMENA GORNJIH VAZDUŠNIH PUTEVA NA KVALITET ŽIVOTA PACIJENATA POSLE HIRURŠKE KOREKCIJE DEFORMITETA III SKELETNE KLASI**" svrstava se u naučnu oblast - Stomatologija, Maksilofacijalna hirurgija, Ortognatska hirurgija. Napisana je na 105 strana sa 9 poglavlja: uvod, pregled literature, ciljevi istraživanja, metodologija, rezultati, diskusija, zaključci, literatura i prilozi. Ilustrovana je sa 27 slika, a rezultati su predstavljeni u 15 tabela. U ovoj doktorskoj disertaciji autor citira 166 bibliografskih jedinica.

## **3. Uvod**

U uvodu disertacije kandidat ističe uticaj ortognatsko-hirurške korekcije III skeletne klase na promene dimenzija gornjih vazdušnih puteva, metode korišćene u proceni promena ovih dimenzija i raznolikost rezultata kod primene izolovanog retropozicioniranja mandibule i bimaksilarne korekcije III skeletne klase. Takođe, ističe značaj promena gornjih vazdušnih puteva na kvalitet života pacijenata.

## **4. Pregled literature**

Pregled literature je dobro sistematizovan i podeljen u šest poglavlja: deformiteti III skeletne klase, ortognatska hirurgija, istorijski razvoj ortognatske hirurgije, skeletne i mekotivne promene nakon hirurške korekcije deformiteta III skeletne klase, korekcija deformiteta III skeletne klase i zastoje disanja u snu, evaluacija gornjih vazdušnih puteva. U prvom poglavlju definisan je deformitet III skeletne klase, način nasleđivanja i dijagnostika. U drugom poglavlju govori se o ulozi

ortognatske hirurgije u tretiranju deformiteta III skeletne klase i vrstama operacija. U trećem poglavlju razmatran je istorijski razvoj ortognatske hirurgije gornje i donje vilice. Četvrto poglavlje ističe skeletne i mekotkivne promene nastale nakon hirurške korekcije deformiteta III skeletne klase. U petom poglavlju predstavljena je literatura koja govori o povezanosti hirurške korekcije deformiteta III skeletne klase i promene dimenzija vazdušnih puteva kao uzrok za nastanak pojave zastoja disanja u snu. Naredno poglavlje sadrži metode za evaluaciju gornjih vazdušnih puteva.

### **5. Ciljevi istraživanja**

Osnovni cilj doktorske disertacije dr Nur Hatab bio je da se ispita hipoteza da li se gornji vazdušni putevi sužavaju nakon hirurške korekcije deformiteta III skeletne klase i kakav je uticaj ove korekcije na postoperativni kvalitet života pacijenata. Iz osnovnog cilja doktorske disertacije, proizašli su zadaci istraživanja:

- Proceniti dvodimenzionalne i trodimenzionalne promene na nivou gornjih vazdušnih puteva kod pacijenata III skeletne klase lečenih izolovanim retroponiranjem donje vilice ili bimaksilarnom hirurškom korekcijom (retroponiranjem donje vilice uz anteriorno pomeranje gornje);
- Proceniti preoperativno psihološko stanje pacijenata odnosno njihovu motivisanost za operativni zahvat;
- Ispitati da li su kod pacijenata preoperativno postojali problemi sa disanjem i snom, i da li je postoperativno došlo do nekih promena;
- Proceniti kvalitet života pre i posle hirurške korekcije deformiteta III klase.

## 6. Metodologija

Za ostvarivanje postavljenih ciljeva i zadataka kandidat je koristio savremenu metodologiju kojom je izvršila precizno merenje promena gornjih vazdušnih puteva i njihov uticaj na kvalitet života posle hirurške korekcije deformiteta III skeletne klase.

U istraživanje su bili uključeni pacijenti koji su se javili na Klinikum za maksilofacijalnu hirurgiju Stomatološkog fakulteta Univerziteta u Beogradu radi korekcije III skeletne klase. Svi pacijenti su pre uključivanja u istraživanje potpisali informisani pristanak za dobrovoljno učešće u studiji. Uzorak od 30 pacijenata bio je podeljen u skladu sa vrstom hirurške korekcije deformiteta III skeletne klase na: pacijente kod kojih je izvršeno izolovano retroponiranje donje vilice (bilateralna sagitalna split osteotomija- BSSO) i pacijente kod kojih je izvršeno retroponiranje donje vilice uz anteriorno pomeranje gornje vilice (BSSO i Le Fort I osteotomija). Svi pacijenti bili su snimani Soredex Scanora 3Dx CBCT skenerom neposredno pre i najmanje 3 meseca nakon hirurške korekcije.

DICOM (Digital Imaging and Communications in Medicine) snimci bili su analizirani u okviru *InVivo 5.0 Anatomage* softvera. Na pre i post operativnom snimku izdvojeni su faringealni vazdušni putevi i izmerena njihova zapremina. Potom je farinks podeljen na tri nivoa: 1) nivo spine nasalis posterior, 2) nivo najniže tačke mekog nepca i 3) nivo vrha epiglotisa. Na svakom od ovih preseka izmerena je površina kao i antero-posteriorna i lateralna širina. Takođe je izmerena zapremina sva tri dela farinksa. Na kraju je određena visina na kojoj se nalazi najveće suženje farinksa u odnosu na spinu nasalis posterior kao i njegova površina.

U *InVivo 5.0 Anatomage* softveru pre i posle operacije bili su određeni kefalometrijski parametri koji govore o promenama položaja i veličine gornje i donje vilice (uglovi SNA, SNB, ANB, GoGn-SN) i procenjen uticaj promene ovih parametara na vazdušne puteve.

Procenu psihičkog zdravlja, mogućih problema sa disanjem i pospanošću i kvaliteta života uopšte kandidat je vršio pomoću standardizovanih upitnika: Psihološka procena ortognatskih pacijenata (Edgerton i Knorr 1971., Peterson i Topazian

1976.); Procena simptoma disajnih problema (Posnick, Fantuzzo i Troost, 2007.); Epworth skala pospanosti (Jons, 1993.); Upitnik o kvalitetu života ortognatskih pacijenata (Slade, 1997).

## **7. Rezultati**

Rezultati su prikazani u skladu sa standardima za ovu vrstu naučno- istraživačkog rada i statistički obrađeni odgovarajućim testovima. Rezultati su podeljeni u dva poglavlja, rezultate dobijene evaluacijom vazdušnih puteva i analizom upitnika. U prvom poglavlju detaljno i postupno se opisuju trodimenzionalne i dvodimenzionalne promene vazdušnih puteva u obe grupe pacijenata, kao i razlike između grupa. Rezultai prikazuju da je u grupi tretiranoj monomaksilarno došlo do značajnog smanjenja celokupne zapremine farinksa i zapremine donje trećine farinksa kao i površina na nivou mekog nepca. Između grupa značajna razlika je nađena u zapremini gornjeg sprata farinksa. U drugom poglavlju kandidat navodi detaljne rezultate upitnika ilustrovane kroz četiri tabele. Rezultati drugog poglavlje ukazuju na blago pogoršanje disajnih problema postoperativno, i poboljšanje kvaliteta života uopšte.

## **8. Diskusija**

Upoređujući svoje rezultate sa rezultatima drugih istraživača koji su bili dostupni, autor u diskusiji izlaže saznanja i činjenice koje doprinose ukupnom razumevanju postavljenog problema.

## **9. Zaključci**

Zaključci istraživanja su jasno formulisani i pružaju odgovore na postavljene ciljeve. Kandidat navodi da se gornji vazšni putevi sužavaju nakon hirurške korekcije deformiteta III skeletne klase, mada ovo suženje nema značajnog uticaja



na pojavu subjektivnih tegoba disanja, kao i da su svi aspekti kvaliteta života bolji postoperativno.

## 10.Literatura

Literatura je sveobuhvatna i savremena. Sadrži 166 jedinica relevantnih za ovu doktorsku disertaciju.

## ZAKLJUČAK

Doktorska disertacija dr Nur Hatab predstavlja dobro dokumentovanu prospektivnu studiju koja daje doprinos u oblasti proučavanja promena gornjih vazdušnih puteva i uticaja tih promena na kvalitet života pacijenata operisanih od deformiteta III skeletne klase. Disertacija predstavlja doprinos u evaluaciji promena dimenzija pojedinačnih delova gornjih vazdušnih puteva nakon hirurške korekcije deformiteta III skeletne klase i njihov uticaj na kvalitet disanja i pospanost, kao i kvalitet života i psihičko zdravlje pacijenata. Kompleksnost teme ove disertacije i dobijeni rezultati ukazuju na zrelost i ozbiljnost kandidata. Postavljeni ciljevi istraživanja su sistematično proučeni primenom adekvatnih naučnih metoda. Rezultati su precizno obrađeni, protumačeni i interpretirani logično i u skladu sa postavljenim ciljevima. Diskusija je detaljna i sveobuhvatna.

Uvidom u dostavljeni tekst, komisija u sastavu Doc. dr Milan Petrović, Prof. dr Predrag Nikolić, Prof. dr Dragan Krasić ocenila je da doktorska disertacija dr Nur Hatab pod nazivom: **“Uticaj promena gornjih vazdušnih puteva na kvalitet života pacijenata posle hirurške korekcije deformiteta III skeletne klase”** predstavlja samostalno, originalno i dobro dokumentovano istraživanje. Doktorska disertacija

zadovoljava sve kriterijume propisane pozitivnim normama sadržanim u Zakonu o Univerzitetima i Stomatološkog fakulteta Univerziteta u Beogradu.

Na osnovu iznetog, predlažemo Nastavno-naučnom veću Stomatološkog fakulteta da prihvati izveštaj i odredi datum javne odbrane ove doktorske disertacije.

U Beogradu,  
18.12.2015.

Doc. dr Milan Petrović

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Prof. dr Predrag Nikolić

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Prof. dr Dragan Krasić

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# Pharyngeal airway changes after mono- and bimaxillary surgery in skeletal class III patients: Cone-beam computed tomography evaluation



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## ABSTRACT

The aim of this study was to evaluate the two-dimensional (2D) and three-dimensional (3D) changes in the pharyngeal airway space (PAS) in 20 class III patients who underwent mono- or bimaxillary surgery using cone-beam computed tomography (CBCT). CBCT examination was obtained before surgery (T1) and at least 3 months after surgery (T2). The pharyngeal airway of each patient was studied at three levels: the level of the posterior nasal spine, the level of the most inferior point of the soft palate, and the level of the top of the epiglottis. At each of these levels, the anteroposterior and lateral dimension as well as cross-sectional area were measured. The volume of the whole PAS and volume between each cross section were also measured. The area and anteroposterior dimensions at the level of the most inferior point of the soft palate significantly decreased in patients who underwent monomaxillary surgery. The volume of the PAS decreased in both groups, but decreased significantly only in the monomaxillary group. The upper volume decreased in the mono- and increased in the bimaxillary group. The lower volume significantly decreased in the monomaxillary group. However, results showed that PAS decreased more after mono- than after bimaxillary surgery.

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## 1. Introduction

Orthognathic surgery aims to correct maxillomandibular skeletal discrepancies in skeletal class III patients that cannot be corrected by orthodontic treatment alone (Hong et al., 2011). Skeletal class III malocclusion can be a result of mandibular prognathism or a maxillary deficiency, or both (Hong, 2011; Li, 2014; Hasebe, 2011; Abdelrahman, 2011). The surgical correction of these malocclusions can be achieved by using either mandibular setback surgery or bimaxillary surgery (maxillary advancement and mandibular setback) (Hong, 2011; Chen, 2007). Skeletal movement can secondarily affect position and tension in the attached soft tissues. These new soft tissue relationships introduce considerable changes in the facial aesthetics and, in addition, in the pharyngeal airway space (PAS) dimensions, especially in the case of a significant

anteroposterior skeletal movements (Lye, 2008; Hernández-Alfaro et al., 2011).

Many authors have reported a decrease in airway dimensions after mandibular setback surgery (Güven, 2005; Hochban, 1996; Hwang, 2010). Others assert that bimaxillary surgery to correct a class III skeletal deformity might have less effect on reduction of the pharyngeal airway than mandibular setback surgery alone (Chen, 2007; Degerliyurt, 2008; Hong, 2011). However, some authors have found no significant changes in the airway after orthognathic surgery to correct class III skeletal discrepancy (Athanasidou, 1991; Eggenesperger, 2005).

This is an issue that is receiving increasing attention because of a possible connection between the narrowing of PAS and development of obstructive sleep apnea (OSA) syndrome.

Many studies have used lateral cephalograms to evaluate changes of PAS after orthognathic surgery in class III patients (Pereira-Filho, 2011; Liukkonen, 2002). The value of lateral cephalometric radiography for pharyngeal airway evaluation is very limited because it gives 2-dimensional (2D) images of complex 3-dimensional (3D) anatomic structures. Cone-beam computed

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tomography (CBCT) is associated with decreased radiation exposure and costs compared with conventional CT, and can be used for orthodontic as well as for surgical diagnosis and treatment planning. CBCT images provide reconstruction of 3D models using computer software. 3D volumetric images allow visualization of the internal structures by eliminating the external structures. In addition, this method allows the possibility of measuring linear distances, the area, and the volume of the airway (Hong et al., 2011).

The purpose of this study was to evaluate 2D and 3D changes of the PAS in patients with skeletal class III deformity treated either by isolated mandibular setback or bimaxillary surgery, and to compare eventual differences of the pharyngeal airway changes after mandibular setback and bimaxillary surgery.

## 2. Material and methods

This is a prospective study that included class III patients treated at the Clinic of Maxillofacial Surgery, School of Dental Medicine, University of Belgrade, from December 2012 until April 2014. This study was reviewed and approved by the ethics committee of the School of Dental Medicine, University of Belgrade. All patients provided written informed consent to participate in the study.

The patients were healthy adults, 9 males and 11 females (Table 1), aged 18–30 years (mean  $21.75 \pm 3.35$  years) with skeletal class III deformity. There were no patients with cleft palate or any syndrome that could include a class III deformity. Patients were divided into two groups according to the type of surgery (Table 1). Group A, monomaxillary (9 patients), treated by mandibular setback surgery—bilateral sagittal split osteotomy (BSSO); and group B, bimaxillary (11 patients), treated by maxillary advancement (Le Fort I osteotomy) and mandibular setback (BSSO). All patients received routine preoperative and postoperative orthodontic treatment.

Preoperative CBCT scans of each patient were taken before surgical treatment (T1). The postoperative CBCT examinations were performed for all patients at least 3 months after surgery (T2). CBCT scans of all 20 patients were obtained using the SCANORA 3Dx (SOREDEX, Tuusula, Finland) CBCT with the following parameters: 90 kV, 10 mA, 18-s scan time, and  $240 \times 165$ -mm field of view. The slice thickness was set at 0.5 mm, and the voxel was isotropic. The scanning was done with the patient sitting in the upright position, with a natural head posture, biting lightly, and the mandible in the centric position.

Each CBCT scan was exported in digital imaging and communications in medicine (DICOM) format, and imported into InVivo 5.2 software (Anatomage, San Jose, CA, USA). The pharyngeal airway was studied in the pre- and postoperative views between the superior border (the line passing from posterior border of the vomer to posterior nasal spine [PNS]) point, and the inferior border (the level of top of the epiglottis parallel to main horizontal plane) (Fig. 1). The pharynx was studied at three levels: the level of the PNS point, the level of the most inferior point of the soft palate, and the level of the top of the epiglottis. The cross-sectional area and lateral as well as anteroposterior dimensions were measured at each level (Fig. 2). The total volume of pharyngeal airway was

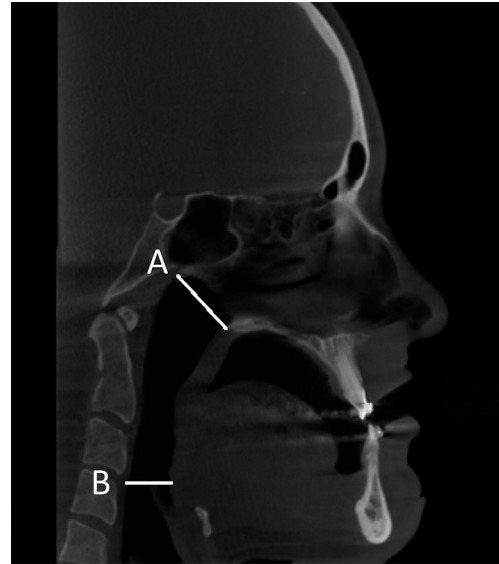


Fig. 1. Limits for the pharyngeal airway measurements. (A) Superior border: line passing from posterior border of the vomer to PNS. (B) Inferior border: level of top of the epiglottis parallel to main horizontal plane.

measured by an automatic software algorithm between the superior and inferior boundaries. The volume of all three parts of pharynx was measured as well: volume 1 between the superior border and the level of the PNS point, volume 2 between PNS and the level of the most inferior point of the soft palate, and volume 3 between the level of the most inferior point of the soft palate and inferior border. Maximum constriction of the pharynx was detected and its area measured automatically by software. The level of maximum constriction was determined according to the posterior nasal spine (Fig. 3 and Fig. 4).

3D cephalometric analysis was performed in pre- and postoperative views, using software option 3D, to determine the sagittal (SNA, SNB, ANB) position of the upper and lower jaw.

Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS for Windows, version 18.0 Chicago, IL, USA) The systematic error was up to standard ( $p < 0.05$ ).

## 3. Results

Demographic characteristics such as age and gender did not appear to have any significant effect on the airway volume.

The cross-sectional area, as well as the anteroposterior dimensions, decreased statistically significantly ( $p < 0.05$ ) in group A on the level of the most inferior point of the soft palate. The area of maximum constriction narrowed statistically significantly in group A and increased slightly in group B (Table 2).

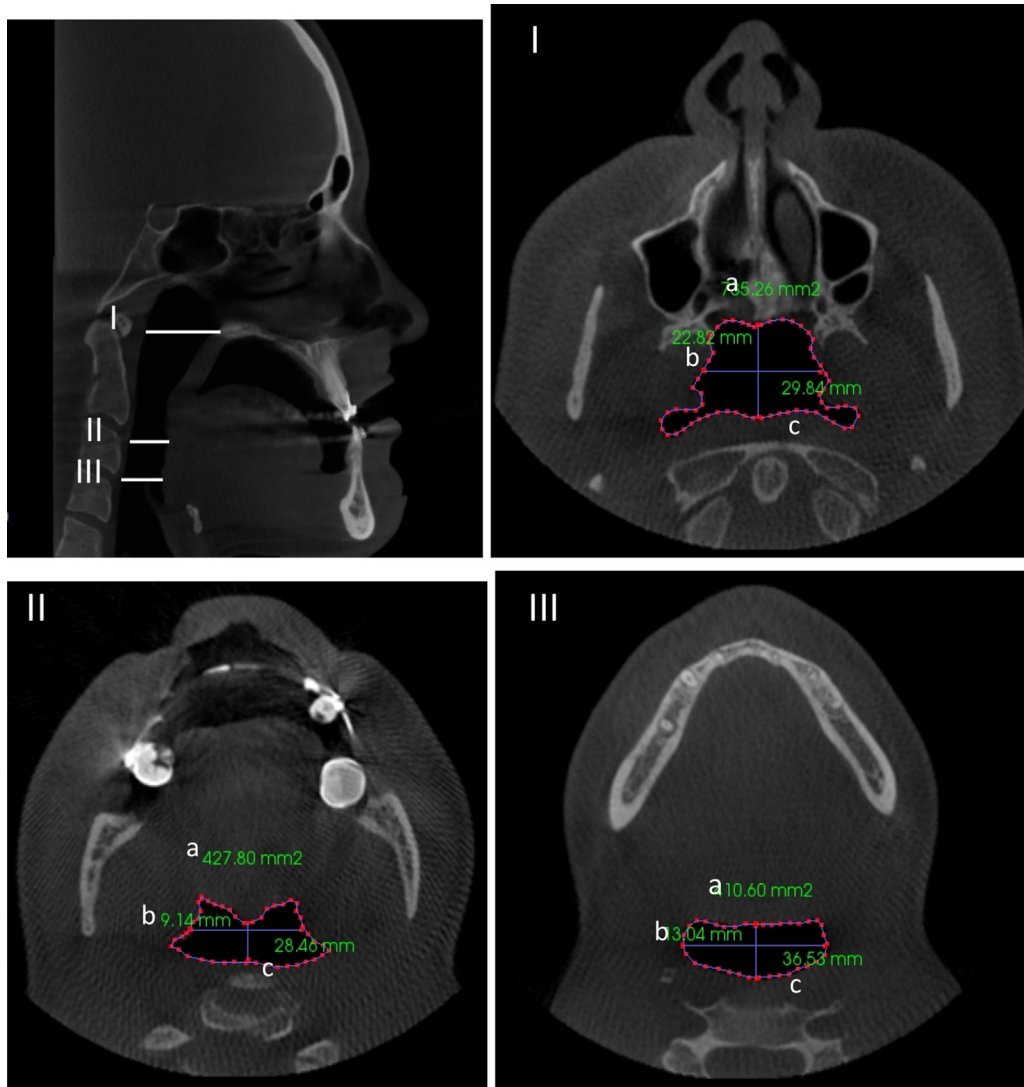
The total volume of the pharyngeal airway decreased in both groups. In group A, the total volume showed statistically significant differences between T1 and T2 ( $p < 0.05$ ). Volume 1 decreased in group A and increased in group B. Volume 2 and volume 3 decreased in both groups, but only volume 3 in group A decreased statistically significantly ( $p < 0.05$ ) (Table 3).

In 2D measurements, significant differences between groups were found in area as well as in anteroposterior dimensions on the level of the most inferior point of the soft palate, and in the area of maximum constriction. A statistically significant difference in PAS changes between groups was found in volume 1 and volume 3.

The mean ANB in group A was  $-2.24^\circ$  preoperatively and  $1.17^\circ$  postoperatively, and in group B was  $-4.07^\circ$  and  $1.41^\circ$  respectively. No correlation between cephalometric and PAS changes was found.

Table 1  
Distribution of patients according to gender and type of surgery.

Gender	Type of surgery		Total
	Monomaxillary	Bimaxillary	
Male	5	4	9
Female	4	7	11
Total	9	11	20



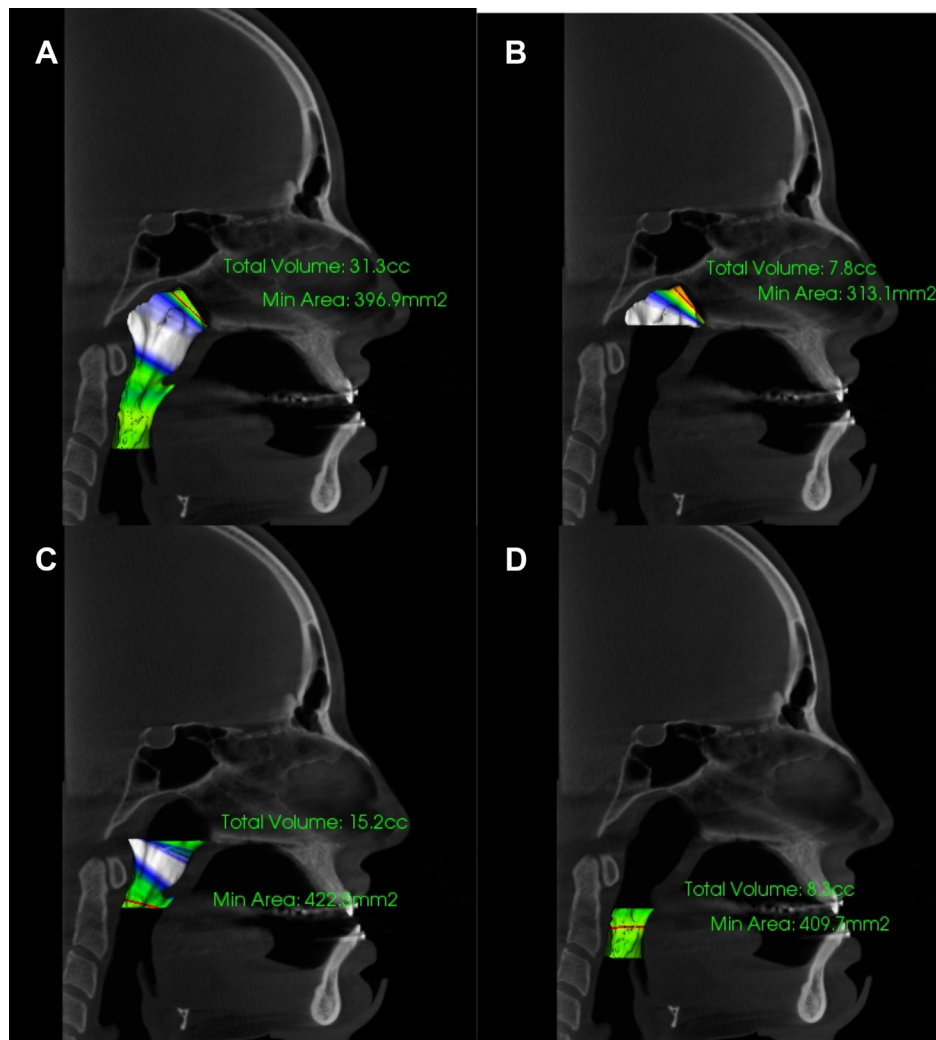
**Fig. 2.** Cross-sectional levels. (I) Level of the PNS point. (II) Level of the most inferior point of the soft palate. (III) Level of the top of the epiglottis. *a* indicates cross-sectional area; *b* indicates lateral dimension; and *c* indicates anteroposterior dimension.

#### 4. Discussion

Cephalometric radiography has been commonly used to evaluate pharyngeal airway changes after orthognathic surgery (Tselnik, 2005; Achilleos, 2000; Liukkonen, 2002; Kawakami, 2005; Chen, 2007). A limitation of these studies has been the use of a two-dimensional technique that does not precisely represent the airway space. Thus, it has been possible to measure only the anteroposterior dimension of PAS. Even more, it has been difficult to evaluate the airway because the hard tissue structures often overlap (Kawamata et al., 2000). CT with 3D reconstruction provides excellent visualization of the pharyngeal airway without hard tissue superimposition, and can create various types of images repeatedly (Kawamata et al., 2000; Fairburn, 2007; Li, 2002; Degerliyurt, 2008). However, conventional CT is not widely used for this purpose because of high radiation exposure and cost. CBCT has proved to be a practical technique for the quantitative assessment of the PAS. It is a noninvasive, low-radiation, fast-scanning technique that is

highly accurate in its measurements. Images are not distorted, and the relative range of the CT units for different tissues provides a method to easily segment the airway (Tso et al., 2009). Using computer software offers a possibility to measure the distances, area of different cross sections and volume of PAS. Due to these advantages, many studies have recently used CBCT for PAS evaluation (Uesugi, 2014; Burkhard, 2014; Li, 2014; Park, 2012; Hong, 2011; Hernández-Alfaro, 2011).

To our knowledge, the present study is the first prospective study to evaluate changes in the PAS by observing separately the volume of all three parts of PAS, as well as cross-sectional areas, after orthognathic surgery. The presented methodology is based on slightly modified measuring of PAS already used in previous studies (Lee, 2012; Sears, 2011; Hong, 2011). To improve the accuracy of detecting changes in PAS after orthognathic surgery, additional new measurements were introduced. The current methodology provides detection of linear as well as volumetric changes in PAS in all three parts. This is an important issue, because eventual narrowing of PAS can result in serious breathing problems and



**Fig. 3.** Measurement of pharyngeal airway volume before surgery. (A) Total volume of pharyngeal airway: from the line passing from posterior border of the vomer to the PNS, to the level of top of the epiglottis, (B) Volume 1: between the superior line passing from the posterior border of the vomer to the PNS and the level of PNS. (C) Volume 2: between the PNS and the level of the most inferior point of the soft palate. (D) Volume 3: between the level of the most inferior point of the soft palate and the top of the epiglottis.

development of OSA syndrome (Hasebe, 2011; Hochban, 1996; Fairburn, 2007; Li, 2002).

In the present study, the PAS was examined at least 3 months after surgery to avoid misinterpretations caused by postoperative edema. The volume of the pharyngeal airway decreased more in the group that underwent monomaxillary than in the group that underwent bimaxillary surgery. Consistent with our findings, other authors have also found a greater tendency of the pharyngeal airway space to decrease after isolated mandibular setback surgery compared with bimaxillary surgery (Hong, 2011; Abdelrahman, 2011; Uesugi, 2014).

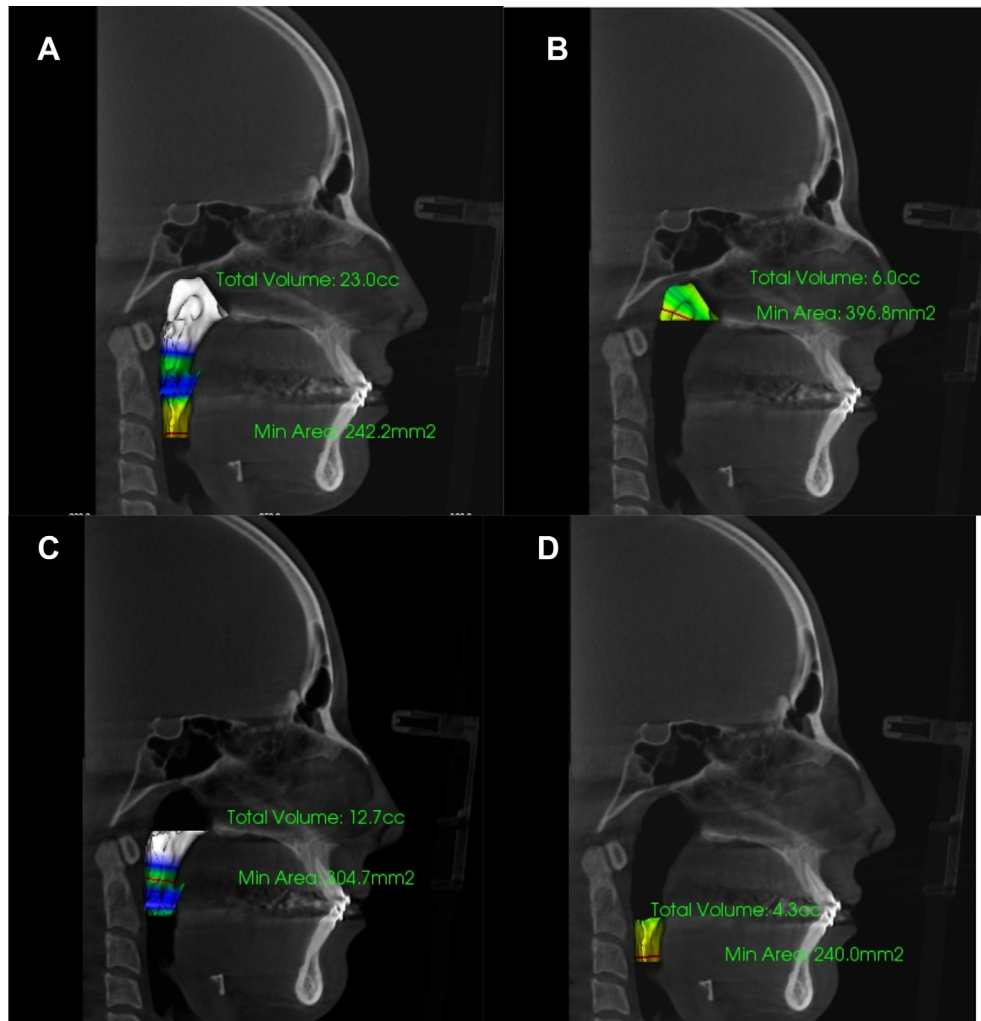
The increase in the upper part and decrease in the lower part of PAS volume and dimension in patients who underwent bimaxillary surgery is in agreement with previous studies as well (Lee, 2012; Jakobsone, 2011).

However, in contrast, some authors reported no significant changes in PAS pre- and post orthognathic surgery to correct class III deformities (Burkhard, 2014; Chen, 2007). Pereira-Filho et al. (2011) reported no changes in the PAS in patients who received mandibular setback surgery, and a significant increase in the PAS in those who underwent maxillary advancement.

## 5. Conclusion

Based on the results of the present study, it can be concluded that the pharyngeal airway narrows after both mandibular setback and bimaxillary surgery in class III patients. However, the amount of narrowing is less in patients undergoing bimaxillary surgery than those undergoing monomaxillary surgery.





**Fig. 4.** Measurement of pharyngeal airway volume after surgery. (A) Total volume of pharyngeal airway: from the line passing from posterior border of the vomer to PNS, to the level of top of the epiglottis. (B) Volume 1: between the superior line passing from the posterior border of the vomer to the PNS and the level of the PNS. (C) Volume 2: between the PNS and the level of the most inferior point of the soft palate. (D) Volume 3: between the level of the most inferior point of the soft palate and the top of the epiglottis.

**Table 2**  
Comparison of 2D measurements between T1 and T2.

2D Measurements	Group A			Group B		
	T1	T2	p value	T1	T2	p value
PNS						
Area (mm <sup>2</sup> )	565.28 ± 167.12	481.35 ± 161.38	.125	634.39 ± 151.12	600.86 ± 132.26	.374
Lateral (mm)	30.32 ± 5.04	27.50 ± 3.92	.070	30.28 ± 3.72	30.27 ± 2.46	.994
Ant-post (mm)	17.38 ± 4.59	17.34 ± 3.64	.767	20.64 ± 4.12	20.76 ± 3.73	.899
Soft Palate						
Area (mm <sup>2</sup> )	409.75 ± 216.36	265.72 ± 211.6	.004*	290.46 ± 168.06	297.31 ± 127.42	.895
Lateral (mm)	21.08 ± 8.18	20.52 ± 7.9	.850	24.2 ± 5.24	22.82 ± 4.43	.247
Ant-post (mm)	13.78 ± 3.87	11.38 ± 5.58	.038*	10.04 ± 4.62	12.11 ± 4.53	.227
Top of epiglottis						
Area (mm <sup>2</sup> )	376.68 ± 186.72	287.3 ± 190.51	.112	283.43 ± 132.6	305.74 ± 128.37	.591
Lateral (mm)	31.04 ± 4.01	27.39 ± 7.98	0.98	30.04 ± 3.67	29.29 ± 4.06	.374
Ant-post (mm)	13.33 ± 5.99	13.89 ± 7.75	.850	11.37 ± 3.49	12.86 ± 4.15	.206
Max constriction area (mm <sup>2</sup> )	303.01 ± 131.29	196.48 ± 128.5	.010*	250.72 ± 153.04	266.1 ± 134.15	.701

Data are presented as mean ± standard deviation. 2D, 2-dimensional; Ant-post, anteroposterior; Max, maximum. Group A: monomaxillary (bilateral sagittal split osteotomy [BSSO], mandibular setback surgery). Group B: bimaxillary (maxillary advancement [Le Fort I osteotomy] and BSSO); T1, preoperative assessment; T2, postoperative assessment; PNS, measurements at the level of posterior nasal spine.

\*Statistically significant at  $p < .05$ .

**Table 3**  
Comparison of 3D measurements between T1 and T2.

3D Measurements	Group A			Group B		
	T1	T2	p value	T1	T2	p value
Total volume	29.95 ± 10.91	22.53 ± 12.65	.001*	30.3 ± 10.61	27.27 ± 9.82	.180
Volume 1	4.73 ± 1.84	4.3 ± 2.42	.481	3.96 ± 2.28	5.6 ± 2.83	.105
Volume 2	15.77 ± 3.75	12.38 ± 7.58	.156	18.67 ± 7.46	18.67 ± 7.46	.084
Volume 3	9.85 ± 7.44	5.85 ± 4.73	.016*	6.76 ± 3.74	6.27 ± 2.86	.093

Data are presented as mean ± standard deviation. 3D, three-dimensional. Groups as in Table 2.

Volume 1, between the superior line passing from the posterior border of the vomer to the PNS and the level of PNS; volume 2, between the PNS and the level of the most inferior point of the soft palate; volume 3, between the level of the most inferior point of the soft palate and top of the epiglottis.

\*Statistically significant at  $p < .05$ .

## Ethical approval

This prospective study was approved by the ethics committee of School of Dentistry, University of Belgrade (No. 36/24).

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## Conflict of interest

None.

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## POTVRDA

U Centralnoj biblioteci Stomatološkog fakulteta urađena je kategorizacija objavljenih radova NUR HATAB, indeksiranih u Web of Science bazi.

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*Jelena Jaćimović*  
Jelena Jaćimović

U Beogradu, 27.04.2015. godine

Na osnovu člana 49. Statuta Stomatološkog fakulteta Univerziteta u Beogradu, Nastavno naučno veće Stomatološkog fakulteta, na IV redovnoj sednici u školskoj 2015/16. godini, održanoj 15.03.2016. godine, donelo je sledeću

## O D L U K U

Usvaja se pozitivan izveštaj Komisije za ocenu završene doktorske disertacije **dr Nur Hatab**, pod nazivom „UTICAJ PROMENA GORNJIH VAZDUŠNIH PUTEVA NA KVALITET ŽIVOTA PACIJENATA POSLE HIRURŠKE KOREKCIJE DEFORMITETA III SKELETNE KLASE“.

Imenovani/a će javno braniti doktorsku disertaciju, ukoliko dobije pozitivno mišljenje Veća naučnih oblasti medicinskih nauka Univerziteta u Beogradu, pred komisijom u sastavu:

1. doc. dr Milan Petrović
2. prof. dr Predrag Nikolić
3. prof. dr Dragan Krasić, Medicinski fakultet u Nišu

## O b r a z l o ž e n j e

Veće naučnih oblasti medicinskih nauka, na sednici od 18.02.2014. godine, dalo je saglasnost na predlog teme doktorske disertacije dr Nur Hatab, pod nazivom „UTICAJ PROMENA GORNJIH VAZDUŠNIH PUTEVA NA KVALITET ŽIVOTA PACIJENATA POSLE HIRURŠKE KOREKCIJE DEFORMITETA III SKELETNE KLASE“.

Imenovani/a je u časopisu „Journal of Cranio-Maxillo-Facial Surgery“, objavio/la rad pod nazivom: „Pharyngeal airway changes after mono- and bimaxillary surgery in skeletal class III patients: Cone-beam computed tomography evaluation (2015).“

Imajući u vidu napred navedeno, Nastavno naučno veće Stomatološkog fakulteta Univerziteta u Beogradu, rešilo je kao u dispozitivu.

Odluku dostaviti: Imenovanom/oj, Univerzitetu u Beogradu, Odseku za nastavu, Veću, Komisiji (3) i Pisarnici.

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Fakultet STOMATOLOŠKI

UNIVERZITET U BEOGRADU

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čl.6 Statuta Univerziteta u Beogradu i čl. 7. st.1  
ovog pravilnika)

\_\_\_\_\_.god.

.Datum)

## ZAHTEV

### za davanje saglasnosti na izveštaj o urađenoj doktorskoj disertaciji

Molimo da, shodno članu 68. st.3. Zakona o univerzitetu ("Službeni glasnik RS" br. 20/98), date saglasnost na

izveštaj o urađenoj doktorskoj disertaciji kandidata NUR ALI HATAB  
(ime, ime jednog od roditelja i prezime)

KANDIDAT NUR ALI HATAB prijavila je doktorsku disertaciju pod nazivom  
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KLASE.“**

Univerzitet je dana 18.02.2014. svojim aktom pod br. 61206-6369/2-2013 dao saglasnost na predlog teme doktorske disertacije koja je glasila

**„UTICAJ PROMENA GORNJIH VAZDUŠNIH PUTEVA NA KVALITET ŽIVOTA  
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KLASE.“**

Komisija za ocenu i odbranu doktorske disertacije kandidata NUR ALI HATAB  
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3. Primedbe date u toku stavljanja izveštaja na uvid javnosti,  
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