

Oznaka poročila: ARRS-RPROJ-ZP-2013/229



ZAKLJUČNO POROČILO RAZISKOVALNEGA PROJEKTA

A. PODATKI O RAZISKOVALNEM PROJEKTU

1. Osnovni podatki o raziskovalnem projektu

Šifra projekta	L3-2351
Naslov projekta	Degeneracija medvretenčne ploščice: raziskava vzrokov in potencial celičneterapije pri zdravljenju
Vodja projekta	17904 Rok Vengust
Tip projekta	L Aplikativni projekt
Obseg raziskovalnih ur	4173
Cenovni razred	C
Trajanje projekta	05.2009 - 04.2012
Nosilna raziskovalna organizacija	312 Univerzitetni klinični center Ljubljana
Raziskovalne organizacije - soizvajalke	7421 EDUCCELL podjetje za celično biologijo d.o.o. Ljubljana
Raziskovalno področje po šifrantu ARRS	3 MEDICINA 3.03 Nevrobiologija
Družbeno-ekonomski cilj	13.03 Medicinske vede - RiR financiran iz drugih virov (ne iz SUF)

2. Raziskovalno področje po šifrantu FOS¹

Šifra	3.02
- Veda	3 Medicinske vede
- Področje	3.02 Klinična medicina

B. REZULTATI IN DOSEŽKI RAZISKOVALNEGA PROJEKTA

3. Povzetek raziskovalnega projekta²

SLO

Degeneracija medvretenčne ploščice je iz socialno- medicinskega in ekonomskega vidika eden večjih problemov sodobnih zdravstvenih sistemov. Mehanizmi degeneracije medvretenčne ploščice v veliki meri še niso razjasnjeni. V projektu smo proučevali strukturo degeneriranih medvretenčnih ploščic s poudarkom na

ugotavljanju prisotnosti imunskih kompleksov. Ugotovljena prisotnost fibrina in v posameznih vzorcih tudi nekaterih molekul, ki sodelujejo v (avto)imunih procesih (IgA, TLR4), kar jasno kaže na vnetne procese na področju herniranega tkiva, ne daje pa dovolj dokazov za potrditev hipoteze o avtoimunem vzroku degeneracije, ki bi bil možen glede na morfogenetski izvor tkiva.

V povezavi z Evropskim projektom GENODISC smo za namen ugotavljanje korelacije med klinično sliko, genotipom in veljavnimi diagnostičnimi metodami (MRI) posredovali v skupno bazo podatke in vzorce 18 bolnikov. Izsledki tega projekta, ki bodo znani v naslednjih letih, bodo pomemben znanstveni in aplikativni prispevek k razumevanju in ustrezni diagnostiki degenerativnih sprememb v medvretenčni ploščici.

V zadnjih letih so vse bolj aktualne ideje o bioloških terapijah degenerirane medvretenčne ploščice, ki se v svetu tudi že izvajajo in preverjajo v kliničnih študijah.

Z vidika razvoja celične terapije za nadomeščanje jedra degenerirane medvretenčne ploščice smo s proučevanjem lastnosti različnih celičnih vrst (chondrocytov iz različnih tkiv, mezenhimskih matičnih celic) skušali definirati tistega, ki bi bil najprimernejši za celično terapijo in regeneracijo jedra degenerirane medvretenčne ploščice. Največ raziskav je potekalo v smislu proučevanja vpliva povečane ozmolarnosti na potencialne celične vire, saj je to eden od kritičnih parametrov okolja v medvretenčni ploščici.

Drug pomemben kritičen parameter je pritisk v medvretenčni ploščici, zato smo izvedli meritve pritiskov v humanih medvretenčnih ter optimizacijo metode vertebroplastike tako, da omogoči ohranjanje ustrezne vrednosti pritiska v medvretenčnem prostoru, kar bo prispevalo k varnosti in učinkovitosti izvajanja teh postopkov v klinični praksi.

K prenosu teh izsledkov v klinično prakso v smislu celične terapije zaenkrat še nismo pristopili iz dveh razlogov:

- prehrana celic in izmenjava snovi je v medvretenčnem prostoru kritični dejavnik, saj je to tkivo največja neožiljena struktura v telesu. Prav neustrezna prehodnost terminalnih plošč sosednjih vretenec je verjetno tudi en ključnih dejavnikov za pojav degeneracije. Z obstoječimi diagnostičnimi metodami ne znamo preveriti, ali bo mikrookolje v medvretenčni ploščici omogočalo celicam ustrezno delovanje da bodo lahko razvile vitalno tkivo z ustreznimi biomehanskimi lastnostmi.
- nivo tehnološkega razvoja tudi še ne daje ustreznih opcij, ki bi zagotavljali uspešno kirurško aplikacijo v smislu, da se vsadek ohrani na ustreznem mestu. Obstajajo tudi podatki, da s kirurško penetracijo anulusa medvretenčne ploščice lahko pospešimo procese degeneracije.

ANG

Intervertebral disc degeneration is one of the biggest problems of modern medicine from socio-medical as well as from economic point of view. Mechanisms of intervertebral disc degeneration are not yet clarified in many aspects.

In the project we will investigate structure of degenerated intervertebral discs with focus on detection of immune complexes in the tissue. Presence of fibrin and in sporadic cases also molecules that are involved in (auto)immune responses (IgA, TLR4) indicate inflammatory processes in the tissue, however these results do not provide enough evidence to support autoimmune hypothesis of disc degeneration (that was proposed according to the morphogenesis of IVD tissue).

In collaboration with EU consortium GENODISC, we provided data and samples from 18 patients to the database of more than 2000 patients. These samples will be used for studies of correlation between genotype, clinical picture and results of currently used diagnostic methods (MRI). These results (that will be available in next years) should have strong scientific and applicative impact regarding understanding and diagnosis of IVD degeneration.

In course of cell therapy development, we investigated phenotype properties of different cell sources (chondrocytes from different cartilaginous tissues, mesenchymal stem cells) in order to define the most suitable cell source for cell therapy and regeneration of nucleus pulposus of degenerated intervertebral disc. Most research was focused on investigation of response of different cell sources to increased osmolarity, that is one of critical parameters in IVD space. The other critical parameter is intervertebral pressure. To study this, we performed measurements of pressures in human intervertebral disc and optimised protocol of vertebroplasty to provide maintenance of regular values of pressure in IVD space, which will contribute to safety and efficiency of these procedures in clinical practice.

Cell therapy approach was not yet transferred into clinical practice for the following reasons:
- exchange of nutrients and gases is a limiting parameter in IVD space as this is the biggest avascular structure in human body. The available diagnostic methods do not allow prediction if

the implanted cells would have appropriate microenvironment that would support normal function of implanted cells and regeneration of tissue with appropriate biomechanical characteristics.
- the stage of technological development does not allow safe and efficient implantation procedure. It has namely been published, that surgical penetration of anulus fibrosus can also facilitate degenerative proceses in IVD.

4. Poročilo o realizaciji predloženega programa dela na raziskovalnem projektu³

Namen projekta je bil prispevek k izbiri ustreznega načina zdravljenja bolezni hrbtenice.

Delovni sklop 1:

Izbira bolnikov, zbiranje kliničnih podatkov in kliničnih vzorcev pri bolnikih z degeneriranimi MVP

Bolniki so bili seznanjeni z raziskavo in so zajeti v raziskavo na podlagi njihove pisne privolitve. Bolniki so izpolnili vprašalnike o zdravstvenem stanju. Zbirali smo vzorce herniiranih medvretenčnih ploščic in krvi ter MR posnetke ledvenega dela hrbtenice. V študijo je bilo zajetih 29 bolnikov.

Delovni sklop 2:

Histopatološka analiza patoloških vzorcev medvretenčne ploščice

Ker je etiologija degeneracije medvretenčne ploščice še vedno v veliki meri nepojasnjena, je bil pomemben cilj projekta proučevanje razlik v morfoloških in biokemijskih lastnostih tkiva normalnih in degeneriranih medvretenčnih ploščic. V ta namen smo zbirali tkiva herniiranih medvretenčnih ploščic, ki so bila operativno odstranjena. Skupno smo zbrali 14 vzorcev tkiva. V namen testiranja hipoteze o avtoimunem vzroku degeneracije, ki se nam glede na morfogenetski izvor tkiva zdi najbolj verjetna, smo v sodelovanju z Inštitutom za patologijo MF, UL izvedli imunohistokemijske analize prisotnosti avtoimunih kompleksov (IgG, IgM, IgA, komplement C3 in C1q). Pozitiven signal IgA je bil pri dveh vzorcih. Dodatno smo izvedli analize TLR2 in 4 receptorjev, ki imajo vlogo v septičnih vnetnih procesih in pri enem od analiziranih dobili pozitiven rezultat. Pri 9 vzorcih je bila prisotna fokalno pozitivna reakcija na fibrin. Ti rezultati kažejo na prisotnost vnetnih procesov v herniiranem tkivu, za sklepanje na avtoimuni vzrok teh vnetnih procesov pa pridobljeni podatki ne zadoščajo.

Delovni sklop 3:

Genotipizacija bolnikov z degeneracijo medvretenčnih ploščic.

Za namen genotipizacije bolnikov smo se povezali z evropskim konzorcijem projekta Genodisc, katerega cilj je prav raziskava genetskih vzrokov degeneracije medvretenčne ploščice. Naši pacienti bodo obravnavani v skupini 2000 bolnikov iz več evropskih držav. V skupno bazo smo posredovali podatke 18 bolnikov.

Delovni sklop 4:

Analiza izražanja tkivno specifičnih genov pri patoloških vzorcih medvretenčne ploščice.

Medvretenčna ploščica je hipocelično tkivo z obilno medceličnino. Količina tkiva je omejena z odvzemom in tudi z ostalimi preiskavami, ki jih želimo izvesti. Izolacija RNA v zadostni količini za analizo izražanja več genskih lokusov je zato problematična in tega tehničnega problema nismo uspeli ustrezno rešiti.

Delovni sklop 5:

celične kulture celic iz tkiva odstranjene hernie discii in analiza izražanja tkivno specifičnih genov

Definirali smo postopke izolacije in gojenja celic iz herniiranega tkiva medvretenčne ploščice. Vzpostavili smo primarne celične kulture iz štirih vzorcev tkiva. Postopki za analizo izražanja tkivno specifičnih genov (agrekan, verzikan, kolagen 2, kolagen 1) z metodo qRT-PCR so bili optimizirani na drugih vrstah hrustančnih celic.

Delovni sklop 6:

Drugi potencialni viri celic za celično terapijo medvretenčne ploščice: celične kulture celic ušesnega hrustanca, ter mezenhimskih matičnih celic; analiza fenotipa celic v smislu primerjave z celicami medvretenčne ploščice

Cilj raziskave je tudi definirati primeren vir celic za regeneracijo medvretenčne ploščice – v letu 2010 so naše aktivnosti potekale na področju izbire ustreznega celičnega vira za namen potencialnih implantacij. S tehnološkega vidika smo obravnavali primernost različnih virov celic: celic jedra medvretenčne ploščice, celic elastičnega hrustanca in mezenhimskih matičnih celic ter opredlili potrebno količino tkiva in zahteve za procesiranje za pridobitev zadostnega števila celic za namen priprave tkivnega nadomestka jedra medvretenčne ploščice. Nadaljevali smo z poglobljenim proučevanjem matičnih celic iz maščobnega tkiva, pri čemer smo ugotavljali vpliv okoljskih dejavnikov (indukcijsko gojišče, hipoksični pogoji, uporaba različnih tridimenzionalnih sistemov gojenja) na njihove proliferacijske in diferenciacijske sposobnosti. Pri proučevanju primernosti celic smo zajeli tudi pogoje, ki so manj ugodni od tistih v normalni medvretenčni ploščici. Pri izvajanju omenjenih raziskav smo v letu 2010 sodelovali z dvema svetovno priznanima tujima laboratorijema – University of Oxford, Department of Physiology, Anatomy and Genetics in University of Ulm, Institut für Unfallchirurgische Forschung und Biomechanik.

Pri več primarnih celičnih kulturah teh celic smo potrdili, da pogoji, ki so značilni za medvretenčno ploščico (višja ozmolarnost in nižje koncentracije kisika) ne vpliva negativno na preživetje teh celic. Rezultati poskusov pa nakazujejo, da je pri višji ozmolarnosti hondrogena diferenciacija matičnih celic iz maščobnega tkiva manj uspešna.

Delovni sklop 7:

Razvoj tkivno-inženirskega vsadka - model za simulacijo 3D okolja medvretenčne

ploščice

V predhodnih poskusih z implantacijo nosilca in celic v medvretenčno ploščico na prašičjem modelu. Pri tem smo opažali da zaradi povišanega pritiska v medvretenčni ploščici pride do ekstruzije vstavljenega materiala kljub zašitju defekta in vstavitvi interspinoznega vsadka. Zato smo letu 2010 smo pridobili mnenje etične komisije za delo na humanih vretencih za izvedbo biomehanske študije pritiskov v medvretenčni ploščici, saj je povečan pritisk ob obremenjevanju le te vzrok za neuspešno implantacijo celičnih kultur v samo medvretenčno ploščico. Pričeli smo z eksplantacijami in preparacijami kadaverskih kompleksov hrbtničnih vretenc in diska med njima in pripravo le-teh za model obremenjevanja. Pri tem sodelujemo z Inštitutom za Sodno medicino Univerze v Ljubljani. Pridobili smo tudi poseben aparat za merjenje tlakov v medvretenčni ploščici, ki se lahko izvaja ob minimalni poškodbi medvretenčne ploščice. Izvedli smo pilotski poskus z enakim protokolom obremenjevanja in merjenja pritiskov na štirih prašičjih kompleksih. Meritve pritiskov smo izvajal na Fakulteti za strojništvo v Ljubljani.

V letu 2011 smo nadaljevali z eksplantacija kadaverskih kompleksov dveh vretenc in medvretenčne ploščice med njima. Komplekse smo pripravili za mehansko obremenjevanje. Pričeli smo s poskusom mehanskega obremenjevanja kompleksa dveh vretenc in medvretenčne ploščice z posebno napravo za obremenjevanje na Fakulteti za strojništvo Univerze v Ljubljani. Ob tem smo merili tako tlak v medvretenčnih ploščicah kot tudi biomehanske lastnosti tkiv, ki smo jih obremenjevali po različnih protokolih. Po obremenjevanju in vertebroplastikah smo medvretenčne ploščice prerezali in ocenili stopnjo degeneracije ter opazovali kako so pritiski v medvretenčni ploščici odvisni od degeneriranosti medvretenčnih ploščic.

V letu 2012 smo opravili vse meritve in analize rezultatov. Pri tem smo našli korelacijo med količino cementa za vertebroplastiko in biomehanskimi značilnostmi medvretenčne ploščice ter optimalno količino cementa za ohranitev tlaka v medvretenčni ploščici.

5. Ocena stopnje realizacije programa dela na raziskovalnem projektu in zastavljenih raziskovalnih ciljev⁴

Ocenjujemo, da je delo na projektu potekalo v skladu za zastavljenimi cilji.

Cilji raziskave, ki smo jih opredelili v prijavi so:

- analiza degeneriranih medvretenčnih ploščic pri izbranih kliničnih indikacijah v primerjavi z zdravim tkivom na morfološkem, histološkem, biokemičnem in celičnem nivoju:
V ta namen smo zbrali tkiva degeneriranih in zdravih medvretenčnih ploščic, za imunohistološke in histološke analize smo se povezali z inštitutom za patologijo MF, UL. Iz tkiv smo izolirali celice in jih namnožili v celičnih kulturah, kar je omogočilo nadaljne analize celičnega fenotipa. V tkivih smo detektirali prisotnost fibrina in tudi imunskih kompleksov, kar ni značilno za zdravo tkivo medvretenčne ploščice in kaže na prisotnost vnetnih procesov v tkivu.
Proučevali smo pritiske v medvretenčni ploščici in vpliv obremenjevanja na tkivo medvretenčne ploščice. S pomočjo posebne naprave za obremenjevanje smo ugotavljali, kako so pritiski v medvretenčni ploščici odvisni od degeneriranosti medvretenčnih ploščic.
- raziskava vzrokov degeneracije medvretenčne ploščice (genetski, okoljski parametri):
Posvetili smo se zlasti analizi markerjev, ki bi kazali na avtoimuni vzrok degeneracije medvretenčne ploščice. Ti rezultati kažejo na prisotnost vnetnih procesov v herniranem tkivu, za sklepanje na avtoimuni vzrok teh vnetnih procesov pa pridobljeni podatki ne zadoščajo.
Za analizo vpliva genetskih in okoljskih dejavnikov smo naše vzorce vključili v evropsko študijo za raziskavo vzrokov degeneracije medvretenčne ploščice GENODISC. Rezultati študije bodo znani v prihodnjem letu.
- definiranje primerne vira celic za zdravljenje degeneriranih medvretenčnih ploščic:
S tehnološkega vidika smo opredelili ustreznost celic elastičnega hrustanca, mezenhimskih matičnih celic kostnega mozga in matičnih celic iz maščobnega tkiva. Večino raziskav smo naredili na matičnih celicah iz maščobnega tkiva in sicer v smislu proučevanja vpliva višje ozmolarnosti na preživetje in sposobnost hondrogene diferenciacije. Pri več primarnih celičnih kulturah teh celic smo potrdili, da pogoji, ki so značilni za medvretenčno ploščico (višja ozmolarnost in nižje koncentracije kisika) ne vplivajo negativno na preživetje teh celic. Rezultati poskusov pa nakazujejo, da je pri višji ozmolarnosti hondrogena diferenciacija matičnih celic iz maščobnega tkiva manj uspešna.

6. Utemeljitev morebitnih sprememb programa raziskovalnega projekta oziroma sprememb, povečanja ali zmanjšanja sestave projektne skupine⁵

Projektne skupini je se pridružil David Martinčič, ki je kot doktorand s področja ortopedije raziskoval biomehanske lastnosti medvretenčne ploščice. Prišlo je do prerazporeditve ur na projektu iz preostalih članov na njega.

Prispevek je objavil na SEG 2012, v pošiljaju je znanstveni članek z opisano tematiko.

7. Najpomembnejši znanstveni rezultati projektne skupine⁶

Znanstveni dosežek			
1.	COBISS ID	0	Vir: vpis v poročilo
	Naslov	SLO	Celični viri za obnovo medvretenčne ploščice
		ANG	Cell sources for nucleus pulposus regeneration.

Opis	SLO	Članek podaja pregled potencialnih virov celic za zdravljenje degenerirane medvretenčne ploščice in podaja pregled kritičnih dejavnikov mikrookolja medvretenčne ploščice s poudarkom na ozmolarnosti. Hkrati podaja pregled celično-terapevtskih pristopov, ki so v uporabi oz. v razvoju ter znanstvena izhodišča, ki opredeljujejo prednosti in pomanjkljivosti posameznih pristopov. Obravnava tudi zakonodajni vidik, ki vpliva na implementacijo teh pristopov v klinično prakso.
	ANG	The article describes potential of different cell sources for treatment of degenerated intervertebral disc. It explains also critical parameters of IVD environment (especially increased osmolarity) and their influence on cell phenotype. It also summarises used and developing cell therapy approaches for treatment of IVD and scientific issues connected to these approaches. Article describes also regulative issues, that influence implementation of these therapeutic approaches into clinical practice.
Objavljeno v	Submitted to European spine journal. Authors: N. Kregar-Velikonja, J. Urban, M. Froehlich, C. Neidlinger-Wilke, D. Kletsas, U. Potocar, S. Tuner, S. Roberts.	
Tipologija	1.02 Pregledni znanstveni članek	

8. Najpomembnejši družbeno-ekonomski rezultati projektne skupine²

Družbeno-ekonomski dosežek			
1.	COBISS ID	27002841	Vir: COBISS.SI
	Naslov	SLO	Celična terapija medvretenčne ploščice: reparacija ali regeneracija
		ANG	Cell therapy of IVD
	Opis	SLO	Predavanje povzema celično-terapevtske pristope, ki so v uporabi oz. v razvoju ter znanstvena izhodišča, ki opredeljujejo prednosti in pomanjkljivosti posameznih pristopov.
		ANG	The lecture summarised used and developing cell therapy approaches for treatment of IVD and scientific issues connected to these approaches.
	Šifra	B.03 Referat na mednarodni znanstveni konferenci	
	Objavljeno v	UMC, Department of orthopaedic surgery; Slovenian spine society]; Final program and abstracts; 2010; Str. 69; Avtorji / Authors: Kregar-Velikonja Nevenka	
Tipologija	1.12 Objavljeni povzetek znanstvenega prispevka na konferenci		
2.	COBISS ID	27003097	Vir: COBISS.SI
	Naslov	SLO	Matične celice za obnovo medvretenčne ploščice
		ANG	Stem cell therapy for intervertebral disc repair
	Opis	SLO	Predavanje prikazuje potencial matičnih celic, zlasti tistih iz maščobnega tkiva, za zdravljenje degenerirane medvretenčne ploščice in podaja pregled kritičnih dejavnikov mikrookolja medvretenčne ploščice s poudarkom na ozmolarnosti in njihov vpliv na fenotip matičnih celic
		ANG	The lecture describes potential of stem cells, especially adipose derived, for treatment of degenerated intervertebral disc. It explains also critical parameters of IVD environment (especially increased osmolarity) and their influence on stem cell phenotype.
	Šifra	B.03 Referat na mednarodni znanstveni konferenci	
	Objavljeno v	UMC, Department of orthopaedic surgery; Slovenian spine society]; Final program and abstracts; 2010; Str. 70; Avtorji / Authors: Fröhlich Mirjam, Kregar-Velikonja Nevenka	

Tipologija	1.12 Objavljeni povzetek znanstvenega prispevka na konferenci
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9. Drugi pomembni rezultati projektne skupine⁸

Rezultati projektne skupine za leto 2012, ki še niso objavljeni v sistemu Cobiss:

Organizacija znanstvenega srečanja (Strokovni dosežek B.01): SEG expert group meeting 2012, Ljubljana, Cankarjev dom, 29.-30.11.2012

Prestavitev znanstvenih in strokovnih dosežkov v povezavi s projektom SEG 2012 (Strokovni dosežki B.012):

- Bridging research of IVD degeneration with clinical need for regenerative treatment - aspects for cell therapy approaches. Authors: Nevenka Kregar-Velikonja¹, Mirjam Froehlich¹, Urška Potočar¹, Cornelia Neidlinger-Wilke², Sally Roberts³, Dimitris Kletsas⁴, Marco Brayda-Bruno⁵, Marta Tibiletti⁵, Jeremy Fairbank⁶, Peter Varga⁷ and Jill Urban⁶
- OPTIMAL CEMENT VOLUME FOR VERTEBROPLASTY: BIOMECHANICAL STUDY. Authors: D. Martinčič, M. Brojan, F. Kosel, D. Štern, T. Vrtovec, R. Vengust

10. Pomen raziskovalnih rezultatov projektne skupine⁹

10.1. Pomen za razvoj znanosti¹⁰

SLO

Delo na projektu bo prispevalo k razumevanju vzrokov degeneracije medvretenčne ploščice, ki še vedno niso pojasnjeni. Nova spoznanja o mehanizmih degeneracije medvretenčne ploščice bodo morda pripomogla k uspešnejšemu zdravljenju in morda celo preventivnemu delovanju, da do degeneracije medvretenčnih ploščic ne bi prišlo.

Razumevanje degenerativnih mehanizmov je pomembno za ustrezno usmerjanje razvoja novih metod zdravljenja obolenj medvretenčne ploščice in s tem daje pomembno podlago aplikativnim raziskavam na tem področju. Zlasti naj bi rezultati prispevali k opredelitvi primernosti celične terapije degenerirane oz. hernirane medvretenčne ploščice.

Raziskave so prispevale tudi k razumevanju ustreznega izvajanja kirurških postopkov, ki se ne nanašajo neposredno na medvretenčno ploščico (npr. vertebroplastika) v smislu preprečevanja degenerativnih sprememb na medvretenčni ploščici, zaradi povečanega pritiska v tkivu.

ANG

With the work on the project, we aim to contribute to the understanding of the etiology of intervertebral disc degeneration, which is still not explained. This is important field for further research since explanation of intervertebral disc degeneration should have influence on disease treatment and prevention.

Understanding of degenerative mechanisms is important for efficient development of novel treatment methods and gives important basis to applicative research in field of intervertebral disc diagnostics and treatment. With these research we want to contribute to the definition of appropriate patient groups for cell therapy of intervertebral disc.

Research contributed also to understanding and appropriate performance of surgical methods that do not directly apply to IVD tissue (e.g. vertebroplasty) in terms of prevention of IVD degeneration due to increased pressure in the tissue.

10.2. Pomen za razvoj Slovenije¹¹

SLO

Potencialni pomen za uporabo rezultatov v Republiki Sloveniji pričakujemo predvsem na področju doprinosov k razumevanju degeneracije medvretenčne ploščice in na podlagi tega

boljše diagnostike bolnikov s tovrstnimi težavami in s tem povezano ustreznim odločanjem o njihovi terapiji.

To področje raziskav je pomembno tudi z vidika mednarodnih, saj se člani projektne skupine povezujejo s priznanimi raziskovalnimi skupinami v tujini. To pa je pomembno tudi iz širšega vidika vpetosti slovenskih raziskav v mednarodni prostor.

ANG

For the society, results of proposed project will be especially important for increase of understanding of intervertebral disc degeneration, and subsequently to better diagnostics and treatment.

This field of research is important also for international collaboration, as project partners collaborate with eminent research groups from this field. This is important in the context of integration of Slovene research into international research network.

11. Samo za aplikativne projekte in podoktorske projekte iz gospodarstva!
Označite, katerega od navedenih ciljev ste si zastavili pri projektu, katere konkretne rezultate ste dosegli in v kakšni meri so doseženi rezultati uporabljeni

Cilj		
F.01	Pridobitev novih praktičnih znanj, informacij in veščin	
	Zastavljen cilj	<input checked="" type="radio"/> DA <input type="radio"/> NE
	Rezultat	<input type="text" value="Dosežen"/>
	Uporaba rezultatov	<input type="text" value="Delno"/>
F.02	Pridobitev novih znanstvenih spoznanj	
	Zastavljen cilj	<input checked="" type="radio"/> DA <input type="radio"/> NE
	Rezultat	<input type="text" value="Dosežen"/>
	Uporaba rezultatov	<input type="text" value="Delno"/>
F.03	Večja usposobljenost raziskovalno-razvojnega osebja	
	Zastavljen cilj	<input checked="" type="radio"/> DA <input type="radio"/> NE
	Rezultat	<input type="text" value="Dosežen"/>
	Uporaba rezultatov	<input type="text" value="Delno"/>
F.04	Dvig tehnološke ravni	
	Zastavljen cilj	<input checked="" type="radio"/> DA <input type="radio"/> NE
	Rezultat	<input type="text" value="Dosežen"/>
	Uporaba rezultatov	<input type="text" value="Delno"/>
F.05	Sposobnost za začetek novega tehnološkega razvoja	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.06	Razvoj novega izdelka	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>

	Uporaba rezultatov	<input type="text"/>
F.07	Izboljšanje obstoječega izdelka	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.08	Razvoj in izdelava prototipa	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.09	Razvoj novega tehnološkega procesa oz. tehnologije	
	Zastavljen cilj	<input checked="" type="radio"/> DA <input type="radio"/> NE
	Rezultat	<input type="text" value="Dosežen bo v naslednjih 3 letih"/>
	Uporaba rezultatov	<input type="text" value="Delno"/>
F.10	Izboljšanje obstoječega tehnološkega procesa oz. tehnologije	
	Zastavljen cilj	<input checked="" type="radio"/> DA <input type="radio"/> NE
	Rezultat	<input type="text" value="Dosežen bo v naslednjih 3 letih"/>
	Uporaba rezultatov	<input type="text" value="Delno"/>
F.11	Razvoj nove storitve	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.12	Izboljšanje obstoječe storitve	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.13	Razvoj novih proizvodnih metod in instrumentov oz. proizvodnih procesov	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.14	Izboljšanje obstoječih proizvodnih metod in instrumentov oz. proizvodnih procesov	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.15	Razvoj novega informacijskega sistema/podatkovnih baz	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE

	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.16	Izboljšanje obstoječega informacijskega sistema/podatkovnih baz	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.17	Prenos obstoječih tehnologij, znanj, metod in postopkov v prakso	
	Zastavljen cilj	<input checked="" type="radio"/> DA <input type="radio"/> NE
	Rezultat	Dosežen bo v naslednjih 3 letih <input type="text"/>
	Uporaba rezultatov	Ni uporabljen <input type="text"/>
F.18	Posredovanje novih znanj neposrednim uporabnikom (seminarji, forumi, konference)	
	Zastavljen cilj	<input checked="" type="radio"/> DA <input type="radio"/> NE
	Rezultat	Dosežen <input type="text"/>
	Uporaba rezultatov	V celoti <input type="text"/>
F.19	Znanje, ki vodi k ustanovitvi novega podjetja ("spin off")	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.20	Ustanovitev novega podjetja ("spin off")	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.21	Razvoj novih zdravstvenih/diagnostičnih metod/postopkov	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.22	Izboljšanje obstoječih zdravstvenih/diagnostičnih metod/postopkov	
	Zastavljen cilj	<input checked="" type="radio"/> DA <input type="radio"/> NE
	Rezultat	Dosežen bo v naslednjih 3 letih <input type="text"/>
	Uporaba rezultatov	Delno <input type="text"/>
F.23	Razvoj novih sistemskih, normativnih, programskih in metodoloških rešitev	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>

F.24	Izboljšanje obstoječih sistemskih, normativnih, programskih in metodoloških rešitev	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.25	Razvoj novih organizacijskih in upravljavskih rešitev	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.26	Izboljšanje obstoječih organizacijskih in upravljavskih rešitev	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.27	Prispevek k ohranjanju/varovanje naravne in kulturne dediščine	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.28	Priprava/organizacija razstave	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.29	Prispevek k razvoju nacionalne kulturne identitete	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.30	Strokovna ocena stanja	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.31	Razvoj standardov	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.32	Mednarodni patent	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>

	Uporaba rezultatov	<input type="text"/>
F.33	Patent v Sloveniji	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.34	Svetovalna dejavnost	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>
F.35	Drugo	
	Zastavljen cilj	<input type="radio"/> DA <input checked="" type="radio"/> NE
	Rezultat	<input type="text"/>
	Uporaba rezultatov	<input type="text"/>

Komentar

12.Samo za aplikativne projekte in podoktorske projekte iz gospodarstva!
Označite potencialne vplive oziroma učinke vaših rezultatov na navedena področja

	Vpliv	Ni vpliva	Majhen vpliv	Srednji vpliv	Velik vpliv	
G.01	Razvoj visokošolskega izobraževanja					
G.01.01.	Razvoj dodiplomskega izobraževanja	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.01.02.	Razvoj podiplomskega izobraževanja	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.01.03.	Drugo: Izobraževanje mladih raziskovalcev-doktorskih študentov	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	
G.02	Gospodarski razvoj					
G.02.01	Razširitev ponudbe novih izdelkov/storitev na trgu	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.02.02.	Širitev obstoječih trgov	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.02.03.	Znižanje stroškov proizvodnje	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.02.04.	Zmanjšanje porabe materialov in energije	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.02.05.	Razširitev področja dejavnosti	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.02.06.	Večja konkurenčna sposobnost	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.02.07.	Večji delež izvoza	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.02.08.	Povečanje dobička	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.02.09.	Nova delovna mesta	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.02.10.	Dvig izobrazbene strukture zaposlenih	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	

G.02.11.	Nov investicijski zagon	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.02.12.	Drugo:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.03	Tehnološki razvoj					
G.03.01.	Tehnološka razširitev/posodobitev dejavnosti	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.03.02.	Tehnološko prestrukturiranje dejavnosti	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.03.03.	Uvajanje novih tehnologij	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	
G.03.04.	Drugo:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.04	Družbeni razvoj					
G.04.01	Dvig kvalitete življenja	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.04.02.	Izboljšanje vodenja in upravljanja	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.04.03.	Izboljšanje delovanja administracije in javne uprave	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.04.04.	Razvoj socialnih dejavnosti	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.04.05.	Razvoj civilne družbe	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.04.06.	Drugo:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.05.	Ohranjanje in razvoj nacionalne naravne in kulturne dediščine in identitete					
G.06.	Varovanje okolja in trajnostni razvoj					
G.07	Razvoj družbene infrastrukture					
G.07.01.	Informacijsko-komunikacijska infrastruktura	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.07.02.	Prometna infrastruktura	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.07.03.	Energetska infrastruktura	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.07.04.	Drugo:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
G.08.	Varovanje zdravja in razvoj zdravstvenega varstva					
G.09.	Drugo:					

Komentar

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13.Pomen raziskovanja za sofinancerje¹²

	Sofinancer		
1.	Naziv	Educell d.o.o.	
	Naslov	Letališka cesta 33, 1000 Ljubljana	
	Vrednost sofinanciranja za celotno obdobje trajanja projekta je znašala:	55.271,32	EUR
	Odstotek od utemeljenih stroškov projekta:	25	%
	Najpomembnejši rezultati raziskovanja za sofinancerja	Šifra	
		Sodelovanje v tem projektu je prispevalo k	

	1.	ovrednotenju potenciala celičnih terapij za zdravljenje degenerirane medvretenčne ploščice.	F.01
	2.	Znanstvena dognanja vpliva ozmolarnosti na matične celice iz maščobnega tkiva	F.02
	3.	V povezavi s tematiko projekta sta delala dva mlada raziskovalca iz gospodarstva	D.09
	4.	Študije vpliva ozmolarnosti na matične celice iz maščobnega tkiva so pomembne tudi z vidika drugih kliničnih aplikacij	F.01
	5.	Znanstveni prispevek poslan za objavo v ESJ	A.01
Komentar	<p>V okviru projekta 'Degeneracija medvretenčne ploščice: raziskava vzrokov in potencial celične terapije pri zdravljenju' so za podjetje Educell velikega pomena rezultati raziskav potencialnih celičnih virov za obnovo tkiva, zlasti matičnih celic in maščobnega tkiva, saj so le te aktualen celični vir tudi za zdravljenje drugih kliničnih indikacij.</p> <p>Z vidika naše organizacije je pomembno, da se je delo na tem projektu komplementarno povezovalo z delom na FP7 projektu GENODISC in da so se v povezavi z obravnavano tematiko v podjetju izobraževali mladi raziskovalci.</p> <p>V pripravi so tudi znanstvene objave. prispevek z naslovom "Cell sources for nucleus pulposus regeneration" je že bil poslan za objavo v European Spine Journal (manuscript number: ESJO-D-12-01238)</p>		
Ocena	<p>Podjetje Educell se ukvarja z razvojem tkivno-inženirskih aplikacij za uporabo v medicini in s servisiranjem klinik s tkivno-inženirskimi storitvami. Raziskovalna skupina Educell je v sodelovanju z Zavodom RS za transfuzijsko medicino in Kliničnim centrom Ljubljana, zlasti Ortopedsko kliniko, razvila tkivno-inženirske metode za zdravljenje aseptičnih lezij sklepnega hrustanca, celjenje kostnega tkiva in zdravljenje vezikoureteralnega refluksa. Glede na projekcije o pomembnosti celičnih terapij je obvladovanje teh tehnologij v našem prostoru velikega pomena za družbo.</p> <p>Razvoj tkivno-inženirskega pristopa k zdravljenju degenerirane medvretenčne ploščice je bilo logično nadaljevanje dotedanjih razvojno raziskovalnih aktivnosti. Podobni pristopi se se razvijajo tudi v drugih centrih. V kontekstu raziskav tega projekta in tudi v povezavi z evropskim konzorcijem GENODISC smo kot raziskovalna skupina na področju razvoja celičnih terapij imeli možnost seznanitve z raznoliko patologijo na področju bolečine v hrbtenici, aktualnega poznavanja vzrokov te bolezni. Načrtovanje celične terapije za obnovo medvretenčne ploščice se je pokazalo kot problematično iz treh vidikov:</p> <ul style="list-style-type: none"> - specifično mikrookolje medvretenčne ploščice je problematično z vidika zagotavljanja ustrezne prehranjenosti vsadka in dolgoročnega preživetja celic v vsadku - pri degeneriranih medvretenčnih ploščicah, je večinoma poškodovan vezivni obroč, oz. ga poškodujemo še z aplikacijo celičnega vsadka. Dosedanje študije kažejo, da obstoječe metode ne zagotavljajo obstoja vsadka na mestu implantacije. - pokazala se je problematika opredelitve ustrezne skupine bolnikov, zlasti z vidika prognoze napredovanja bolezni oz bolečine v hrbtenici. s tega vidika je težko opredeliti 'cost-benefit' tovrstnega zdravljenja <p>Glede na navedeno v podjetju Educell ne bomo nadaljevali z razvojem celičnega produkta za zdravljenje za nadomeščanje degeneriranega ali herniiranega jedra medvretenčne ploščice, dokler ne bodo znanstvena in tehnološka spoznanja omogočila razrešitve naštetih dilem.</p> <p>Vsekakor pa je delo na tem projektu pomembno prispevalo k poznavanju potenciala proučevanih virov celic tudi za druge tkivno-inženirske aplikacije, k dvigu usposobljenosti raziskovalno-razvojnega kadra v</p>		

	podjetju in k poznavanju problematike degeneracije medvretenčne ploščice in s tem povezane bolečine v hrbtenici.
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14. Izjemni dosežek v letu 2012¹³

14.1. Izjemni znanstveni dosežek

V objavo smo poslali pregledni znanstveni članek, ki v veliki meri vsebuje tudi rezultate našega raziskovanja.

14.2. Izjemni družbeno-ekonomski dosežek

Na Ortopedski kliniki smo organizirali mednarodni simpozij Spine experts group meeting 2012 in Slovenia spine symposium 2012, kjer sta bila dva sklopa posvečena izključno bazični znanosti na področju degeneracije medvretenčne ploščice in pa operativnim terapijam degeneracije medvretenčne ploščice. Dogodka so se udeležili eminentni raziskovalci in kirurgi iz cele evrope.

C. IZJAVE

Podpisani izjavljam/o, da:

- so vsi podatki, ki jih navajamo v poročilu, resnični in točni
- se strinjamo z obdelavo podatkov v skladu z zakonodajo o varstvu osebnih podatkov za potrebe ocenjevanja ter obdelavo teh podatkov za evidence ARRS
- so vsi podatki v obrazcu v elektronski obliki identični podatkom v obrazcu v pisni obliki
- so z vsebino zaključnega poročila seznanjeni in se strinjajo vsi soizvajalci projekta

Podpisi:

*zastopnik oz. pooblaščen oseba
raziskovalne organizacije:*

in

vodja raziskovalnega projekta:

Univerzitetni klinični center Ljubljana

Rok Vengust

ŽIG

Kraj in datum:

Oznaka prijave: ARRS-RPROJ-ZP-2013/229

¹ Opredelite raziskovalno področje po klasifikaciji FOS 2007 (Fields of Science). Prevajalna tabela med raziskovalnimi področji po klasifikaciji ARRS ter po klasifikaciji FOS 2007 (Fields of Science) s kategorijami WOS (Web of Science) kot podpodročji je dostopna na spletni strani agencije (<http://www.arrs.gov.si/sl/gradivo/sifranti/preslik-vpp-fos-wos.asp>). [Nazaj](#)

² Napišite povzetek raziskovalnega projekta (največ 3.000 znakov v slovenskem in angleškem jeziku) [Nazaj](#)

³ Napišite kratko vsebinsko poročilo, kjer boste predstavili raziskovalno hipotezo in opis raziskovanja. Navedite ključne ugotovitve, znanstvena spoznanja, rezultate in učinke raziskovalnega projekta in njihovo uporabo ter sodelovanje s tujimi partnerji. Največ 12.000 znakov vključno s presledki (približno dve strani, velikost pisave 11). [Nazaj](#)

⁴ Realizacija raziskovalne hipoteze. Največ 3.000 znakov vključno s presledki (približno pol strani, velikost pisave 11) [Nazaj](#)

⁵ V primeru bistvenih odstopanj in sprememb od predvidenega programa raziskovalnega projekta, kot je bil zapisan v predlogu raziskovalnega projekta oziroma v primeru sprememb, povečanja ali zmanjšanja sestave projektne skupine v zadnjem letu izvajanja projekta, napišite obrazložitev. V primeru, da sprememb ni bilo, to navedite. Največ 6.000 znakov vključno s presledki (približno ena stran, velikost pisave 11). [Nazaj](#)

⁶ Navedite znanstvene dosežke, ki so nastali v okviru tega projekta. Raziskovalni dosežek iz obdobja izvajanja projekta (do oddaje zaključnega poročila) vpišete tako, da izpolnite COBISS kodo dosežka – sistem nato sam izpolni naslov objave, naziv, IF in srednjo vrednost revije, naziv FOS področja ter podatek, ali je dosežek uvrščen v A" ali A'. [Nazaj](#)

⁷ Navedite družbeno-ekonomske dosežke, ki so nastali v okviru tega projekta. Družbeno-ekonomski rezultat iz obdobja izvajanja projekta (do oddaje zaključnega poročila) vpišete tako, da izpolnite COBISS kodo dosežka – sistem nato sam izpolni naslov objave, naziv, IF in srednjo vrednost revije, naziv FOS področja ter podatek, ali je dosežek uvrščen v A" ali A'.

Družbeno-ekonomski dosežek je po svoji strukturi drugačen kot znanstveni dosežek. Povzetek znanstvenega dosežka je praviloma povzetek bibliografske enote (članka, knjige), v kateri je dosežek objavljen.

Povzetek družbeno-ekonomskega dosežka praviloma ni povzetek bibliografske enote, ki ta dosežek dokumentira, ker je dosežek sklop več rezultatov raziskovanja, ki je lahko dokumentiran v različnih bibliografskih enotah. COBISS ID zato ni enoznačen, izjemoma pa ga lahko tudi ni (npr. prehod mlajših sodelavcev v gospodarstvo na pomembnih raziskovalnih nalogah, ali ustanovitev podjetja kot rezultat projekta ... - v obeh primerih ni COBISS ID). [Nazaj](#)

⁸ Navedite rezultate raziskovalnega projekta iz obdobja izvajanja projekta (do oddaje zaključnega poročila) v primeru, da katerega od rezultatov ni mogoče navesti v točkah 7 in 8 (npr. ker se ga v sistemu COBISS ne vodi). Največ 2.000 znakov, vključno s presledki. [Nazaj](#)

⁹ Pomen raziskovalnih rezultatov za razvoj znanosti in za razvoj Slovenije bo objavljen na spletni strani: <http://sicris.izum.si/> za posamezen projekt, ki je predmet poročanja [Nazaj](#)

¹⁰ Največ 4.000 znakov, vključno s presledki [Nazaj](#)

¹¹ Največ 4.000 znakov, vključno s presledki [Nazaj](#)

¹² Rubrike izpolnite / prepisite skladno z obrazcem "izjava sofinancerja" <http://www.arrs.gov.si/sl/progproj/rproj/gradivo/>, ki ga mora izpolniti sofinancer. Podpisan obrazec "Izjava sofinancerja" pridobi in hrani nosilna raziskovalna organizacija – izvajalka projekta. [Nazaj](#)

¹³ Navedite en izjemni znanstveni dosežek in/ali en izjemni družbeno-ekonomski dosežek raziskovalnega projekta v letu 2012 (največ 1000 znakov, vključno s presledki). Za dosežek pripravite diapozitiv, ki vsebuje sliko ali drugo slikovno gradivo v zvezi z izjemnim dosežkom (velikost pisave najmanj 16, približno pol strani) in opis izjemnega dosežka (velikost pisave 12, približno pol strani). Diapozitiv/-a priložite kot priponko/-i k temu poročilu. Vzorec diapozitiva je objavljen na spletni strani ARRS <http://www.arrs.gov.si/sl/gradivo/>, predstavitev dosežkov za pretekla leta pa so objavljena na spletni strani <http://www.arrs.gov.si/sl/analize/dosez/>. [Nazaj](#)

Obrazec: ARRS-RPROJ-ZP/2013 v1.00
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Cell sources for nucleus pulposus regeneration

N. Kregar-Velikonja, J. Urban, M. Froehlich, C. Neidlinger-Wilke, D. Kletsas, U. Potocar, S. Tuner, S. Roberts.

Abstract

There is increasing interest in the development of cell therapy as a possible approach for the treatment of degenerative disc disease. Choosing the appropriate cell source is a prerequisite for the successful outcome of disc cell therapy and implanted cells should be able to survive and produce tissue of the desired quality. Several cell sources have been proposed for disc cell therapies, including nucleus pulposus cells, chondrocytes and mesenchymal stem cells derived from bone marrow and adipose tissue. For the purpose of regeneration of nucleus pulposus tissue, the cells must produce an appropriate proteoglycan-rich matrix, as this is essential for the functioning of the intervertebral disc. The natural environment within the disc is very challenging to implanted cells, particularly if they have been culture-expanded in normal laboratory conditions. In this review, we discuss potential cell sources for regeneration of the nucleus pulposus and the influence of the intervertebral disc microenvironment on the cell phenotype. We also discuss issues associated with cell culture and technical preparation of cell products in relation to current regulatory requirements. Regulatory issues are often not considered but are hugely important and may be the ultimate deciding factor as far as which therapies progress to the clinic.



November 29th and 30th, 2012
Ljubljana, Slovenia



Spine Experts Group
Slovenian Spine Society
Department of Orthopaedic Surgery, UMC Ljubljana

ANNUAL SPINE EXPERTS
GROUP MEETING AND
SLOVENIA 2012 SPINE SYMPOSIUM

FINAL PROGRAM
AND ABSTRACTS

WELCOME GREETINGS

Dear friends and colleagues,

On behalf of the Spine Experts Group and Slovenian Spine Society we would like to extend a warm welcome to the **Spine Experts Group Meeting 2012**. We hope that you will experience an enjoyable stay in Slovenia.

The modern way of life and aging population has prompted the degenerative spine conditions to be constantly on the increase. Many of these patients, especially those whose lumbar spine has been affected, will need operative treatment at some point in their lives. Even greater is the increase of patients who will need surgery for metastatic and infectious lumbar spine affection.

New surgical techniques and stabilization devices have emerged recently in reply to the increasing surgical challenges. That is why the topics of the Spine Experts Group Meeting 2012 will deal with various implants in degenerative conditions and trauma as well as surgical techniques in infectious and metastatic diseases.

Special thanks to you, the outstanding invited speakers, and to all the presenting authors and your co-authors, who have contributed to an exciting and stimulating scientific programme. We have tried to make the meeting accessible and attractive.

Thank you for joining us in November 2012 in Ljubljana.

Yours sincerely,



President of the Organising Committee

Prof. dr. Rok Vengust

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Rok Vengust, Slovenia
Matjaž Voršič, Slovenia

Invited Speakers

Max Aebi (SUI)
Ufuk Aydınli (TUR)
Massimo Balsano (ITA)
Daniel Chopin (FRA)
Anastasios Christodoulou (GR)
Tai Friesem (UK)
Dezső Jészenszky (SUI)
Hans Jörg Meisel (GER)
Zdenko Milinković (SRB)
Homere Mouchaty (ITA)
Sally Roberts (UK)
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SCIENTIFIC PROGRAM

THURSDAY, NOVEMBER 29, 2012 *Kosovel Hall*

08:30	08:50	WELCOME ADDRESSES
08:50	10:00	INSTRUMENTATION IN DEGENERATIVE SPINE DISORDERS Chairs: U. Aydinli, H. Mouchaty
08:50	09:10	THE CORRELATION BETWEEN SPINAL DECOMPRESSION AND PATIENT OUTCOME A. M. Aksakal , C. Ermutlu , B. Akesen , <u>U. Aydinli</u> (TURKEY)
09:10	09:30	TWO LEVEL AXIALIF ANTERIOR FUSION H. Mouchaty (ITALY)
09:30	09:40	OPERATIVE TREATMENT OF LUMBAR SPINE SPONDYLOLISTHESIS <u>I. Kaftandziev</u> , S. Trpeski, V. Filipce, O. Arsovski, I. Hasani, L. Nikolov, A. Kaev (REPUBLIC OF MACEDONIA)
09:40	09:50	RESULTS OF TREATMENT OF DEGENERATIVE LUMBAR SPINAL STENOSIS (DLSS) WITH THE ADJUNCT OF INTERSPINOUS PROCESS DEVICES TO SURGICAL DECOMPRESSION <u>S. Fokter</u> , A. Strahovnik (SLOVENIA)
09:50	10:00	PEDICLE SCREW PLACEMENT IN L/S SPINE USING RAPID PROTOTYPING DRILL GUIDE TEMPLATE <u>M. Merc</u> , I. Drstvensek, M. Vogrin, T. Brajljeh, G. Rečnik (SLOVENIA)
10:00	10:30	COFFEE BREAK
10:30	13:05	MISS/LISS AND MOTION PRESERVATION TECHNOLOGY Chairs: M. Aebi, T. Friesem
10:30	10:55	MISS/LISS IN DEGENERATIVE CONDITIONS: CURRENT TRENDS M. Aebi (SWITZERLAND)
10:55	11:15	TOTAL DISC ENDOPROTHESIS OF THE CERVICAL SPINE: PEEK VS METAL T. Friesem (UNITED KINGDOM)
11:15	11:25	DISCOVER TOTAL CERVICAL DISC ARTHROPLASTY IN SURGICAL TREATMENT OF A SINGLE LEVEL CERVICAL DISC DISEASE <u>M. Vukić</u> , M. Rozankovic, S. Marasanov (CROATIA)
11:25	11:35	SINGLE- AND MULTI-LEVEL CERVICAL ARTHROPLASTY: COMPARISON OF CLINICAL AND RADIOLOGICAL OUTCOMES 5 YEARS AFTER CERVICAL DISC REPLACEMENT WITH PRODISC-C PROSTHESIS <u>M. Voršič</u> , G. Bunc, T. Strojnik, J. Ravnik, T. Velnar (SLOVENIA)
11:35	11:45	PARTIAL DISC ENDOPROSTHESIS OF LUMBAR SPINE: A NEW TREATMENT OPTION <u>L. Boriani</u> , M. Balsano (ITALY)
11:45	11:55	THE INFLUENCE OF TOTAL DISC ARTHROPLASTY WITH MOBIDISC PROSTHESIS ON LUMBAR SPINE AND PELVIC PARAMETERS - PROSPECTIVE IN VIVO BIOMECHANICAL STUDY WITH A 3 YEAR OF FOLLOW <u>A. Vujadinović</u> , D. Aldakheel, J. Steib (BOSNIA AND HERZEGOVINA)
11:55	12:05	PERCUTANEOUS FIXATION WITH INDIRECT NEUROFORAMINAL DECOMPRESSION FOR LOW GRADE ISTHMIC SPONDYLOLISTHESIS WITH RADICULOPATHY <u>R. Vengust</u> , R. Košak (SLOVENIA)

12:05	12:15	PERCUTANEOUS INSTRUMENTATION WITH INDIRECT NEUROFORAMINAL DECOMPRESSION FOR LOW-GRADE ISTHMIC SPONDYLOLISTHESIS WITH RADICULOPATHY <u>G. Rečnik, M. Milčič</u> (SLOVENIA)
12:15	12:25	FORAMINAL DECOMPRESSION AND MINIMALLY INVASIVE INTERSPINAL STABILIZATION IN DEGENERATIVE LUMBAR STENOSIS- INDICATIONS, SURGICAL TECHNIQUE AND EARLY RESULTS. <u>V. Rosmanov, I. Palev, M. Kabalan, I. Altandjiiski, A. Georgieva, J. Georgiev</u> (BULGARIA)
12:25	12:35	EARLY BALLOON KYPHOPLASTY IN FRAGILITY VERTEBRAL COMPRESSION FRACTURES INFLUENCES QUALITY OF LIFE <u>R. Komadina, M. Vlaović, D. Brilej</u> (SLOVENIA)
12:35	12:45	OPTIMAL CEMENT VOLUME FOR VERTEBROPLASTY: BIOMECHANICAL STUDY <u>D. Martinčič, M. Brojan, F. Kosel, D. Štern, T. Vrtovec, R. Vengust</u> (SLOVENIA)
12:45	12:55	BALLOON KYPHOPLASTY IN TRAUMATIC FRACTURES OF THE THORACOLUMBAR SPINE AS STANDALONE TECHNIQUE OR COMBINED WITH POSTERIOR STABILIZATION TECHNIQUES <u>D. Brilej, M. Vlaović, R. Komadina</u> (SLOVENIA)
12:55	13:05	MINIMALLY INVASIVE POSTERIOR STABILIZATION OF THORACOLUMBAR SPINE FRACTURES <u>M. Vesel, B. Čopić, S. Al Mawed, M. Dobravec, M. Jug, S. Herman, U. Tominc</u> (SLOVENIA)
13:05	14:30	LUNCH
14:30	16:40	MANAGEMENT OF SAGITTAL BALANCE DISORDERS AND SCOLIOSIS Chairs: D. Chopin, Z. Milinković
14:30	14:55	SPINOPELVIC SAGITTAL BALANCE: BASIC PRINCIPLES <u>D. Chopin</u> (FRANCE)
14:55	15:20	IMPACT OF SAGITTAL BALANCE ON SURGICAL TREATMENT OF DEGENERATIVE SPONDYLOLISTHESIS AND DEGENERATIVE SCOLIOSIS <u>D. Chopin</u> (FRANCE)
15:20	15:35	SPINAL DEFORMITIES IN CHILDREN AND COMPETITIVE SPORT <u>Z. Milinković, I. Milinković, N. Dikić, M. Andjelković</u> (SERBIA)
15:35	15:45	ANALYSIS OF OUTCOME OF SCOLIOSIS OPERATIVE TREATMENT FROM JANUARY 2000 TO DECEMBER 2010 IN VALDOLTRA ORTHOPAEDIC HOSPITAL <u>N. Hero</u> (SLOVENIA)
15:45	15:55	DUAL GROWING ROD TECHNIQUE IN EARLY ONSET SCOLIOSIS <u>M. Ozalay, M. Uysal, A. Derincek</u> (TURKEY)
15:55	16:05	OUR EXPERIENCE AND EARLY RESULTS WITH A COMPLEMENTARY IMPLANT FOR THE CORRECTION OF MAJOR THORACIC CURVES <u>Z. Csernatony, L. Kiss</u> (HUNGARY)
16:05	16:15	THE 'GSCI INDEX' : A NOVEL PARAMETER FOR THE ASSESSMENT OF ADOLESCENT IDIOPATHIC SCOLIOSIS CORRECTION <u>E. Kamaric</u> (USA)

16:15	16:40	CLINICAL EXPERIENCE IN CELL-BASED THERAPEUTICS: DISC CHONDROCYTE TRANSPLANTATION A TREATMENT FOR DEGENERATED OR DAMAGED INTERVERTEBRAL DISC. H. Meisel, V. Siodla, T. Ganey, Y. Minkus, W. Hutton, O. Alasevic (GERMANY)
16:40	17:00	<i>COFFEE BREAK</i>
17:00	18:30	SURGICAL TREATMENT IN CERVICAL SPINE TRAUMA AND DEGENERATIVE CONDITIONS Chairs: D. Jeszenszky, M. Vesel
17:00	17:20	STRATEGY AND TREATMENT OPTIONS IN HIGH CERVICAL TRAUMA D. Jeszenszky (SWITZERLAND)
17:20	17:30	CERVICOTHORACIC INSTABILITY - A CHALLENGE TO TREAT? U. Tominc, M. Vesel, S. Al Mawed, M. Dobravec, M. Jug, S. Herman (SLOVENIA)
17:30	17:40	SPINAL CORD INJURY IN PREGNANCY: A CASE REPORT AND LITERATURE REVIEW V. Bilić, T. Banić, Z. Kejla (CROATIA)
17:40	17:50	GUNSHOT WOUND TO THE UPPER THORACIC SPINE ASSOCIATED WITH PERFORATED ESOPHAGUS - CASE REPORT I. Hasani, I. Kaftandziev, S. Trpeski, L. Nikolov, G. Velkovski (REPUBLIC OF MACEDONIA)
17:50	18:00	VERTEBRAL ARTERY INJURY DURING REPOSITION AND FIXATION OF FRACTURED C4 VERTEBRA SUCCESSFULLY TREATED WITH ENDOVASCULAR APPROACH T. Banić, N. Somun, V. Bilić, V. Pavić, I. Coc, I. Cvjetko, T. Kokić, M. Mimica, Z. Kejla (CROATIA)
18:00	18:10	OUR EXPERIENCES IN SURGICAL MANAGEMENT OF CERVICAL SPONDYLOTIC MYELOPATHY WITH LAMINECTOMY T. Strojnik, M. Voršič, G. Bunc, J. Ravnik, T. Smigoc (SLOVENIA)
18:10	18:20	A TETRAPLEGIA SYNDROME OCCURRING AFTER ADEQUATE ANTERIOR AND POSTERIOR DECOMPRESSION FOR CERVICAL SPONDYLOARTHROSIS: BIOMECHANICS OF INJURY CASE REPORT D. Haritonov, S. Kalevski (BULGARIA)
18:20	18:30	PRIMARY SURGICAL TREATMENT OF SYMPTOMATIC ANTERIOR CERVICAL OSTEOPHYTES: PLAIN RESECTION OR INSTRUMENTED FUSION? M. Vodičar, R. Košak, R. Vengust (SLOVENIA)
20:00		<i>CONFERENCE DINNER Club CD (Cultural and Congress Center Cankarjev dom)</i> <i>Welcome address by Mr. Zoran Janković, Mayor of Ljubljana.</i>

FRIDAY, NOVEMBER 30, 2012

08:30	10:05	BASIC SCIENCE IN DEGENERATIVE SPINE DISORDERS Chairs: J. Urban, S. Roberts
08:30	08:50	NUTRITION OF THE INTERVERTEBRAL DISC <u>J. Urban</u> , M. Tibiletti, C. Niedlinger-Wilke, P. Winlove, J. Fairbank, O. Boubriak (UNITED KINGDOM)
08:50	09:10	ANGIOGENESIS AND NEUROGENESIS IN DISC DEGENERATION <u>S. Roberts</u> , P. Jones, S. Owen, B. Balain (UNITED KINGDOM)
09:10	09:25	BRIDGING RESEARCH OF IVD DEGENERATION WITH CLINICAL NEED FOR REGENERATIVE TREATMENT - ASPECTS FOR CELL THERAPY APPROACHES <u>N. Kregar Velikonja</u> , F. Froehlich, U. Potočar, C. Neidlinger-Wilke, S. Roberts, D. Kletsas, M. Brayda-Bruno, M. Tibiletti, J. Fairbank, P. Varga, J. Urban (SLOVENIA)
09:25	09:35	ISOLATION OF HUMAN NUCLEUS PULPOSUS AND ANNULUS FIBROSUS CELLS <u>L. Gradišnik</u> , <u>T. Velnar</u> , A. Cencič (Slovenia)
09:35	09:45	ULTRASTRUCTURE OF LUMBAR VERTEBRAE BIOMINERAL WHEN HYDROXYLAPATITE MATERIAL SATURATED WITH ZINC IS IMPLANTED IN THE TIBIA <u>V. Luzin</u> , V. Korotun, A. Yeryomin (UKRAINE)
09:45	09:55	ASSOCIATION BETWEEN CHD7 AND IL-6 GENE POLYMORPHISMS AND IDIOPATHIC SCOLIOSIS IN BULGARIANS: A PILOT STUDY <u>S. Nikolova</u> , M. Dikova, D. Dikov, A. Dzherov, D. Lashkov, P. Tanchev (BULGARIA)
09:55	10:05	CLINICAL SUBGROUPS OF LOW BACK PAIN PATIENTS ARE SIGNIFICANTLY RELATED TO SURGICAL OUTCOME <u>A. Lazary</u> , Z. Szoverfi, A. Bozsodi, I. Klemencsics, P. Varga (HUNGARY)
10:05	10:35	<i>COFFEE BREAK</i>
10:35	12:25	SURGICAL TREATMENT OF ELDERLY SPINE AND SPINE INFECTIONS Chairs: M. Aebi, J. Saveski
10:35	11:00	SURGICAL TREATMENT OF ELDERLY SPINE: STATE OF THE ART <u>M. Aebi</u> (SWITZERLAND)
11:00	11:15	OUR EXPERIENCE WITH THE USE OF BONE CEMENT IN DEGENERATIVE SPINE SURGERY <u>M. Rónaj</u> , P. Varga (HUNGARY)
11:15	11:25	REOPERATIONS OF THE PATIENTS WITH THE LUMBAR SPINE STENOSIS IN GENERAL HOSPITAL JESENICE A. Prlja (SLOVENIA)
11:25	11:35	SPINAL INFECTIONS - DIAGNOSIS AND TREATMENT <u>J. Saveski</u> , N. Trajkovska, I. Hasani, I. Kaftandziev (REPUBLIC OF MACEDONIA)
11:35	11:45	SPONDYLODISCITIS, DIAGNOSTIC AND TREATMENT DUBIOSIS <u>N. Vukčević</u> , O. Laković (MONTENEGRO)
11:45	11:55	ANTEROPOSTERIOR INSTRUMENTATION WITH SINGLE POSTERIOR APPROACH FOR TREATMENT OF PYOGENIC OSTEOMYELITIS OF THORACIC AND LUMBAR SPINE <u>M. Gorenšek</u> , M. Gorenšek, R. Košak, L. Travnik, R. Vengust (SLOVENIA)

11:55	12:05	OPERATIVE TREATMENT OF SPINAL TUBERCULOSIS <u>L. Travnik</u> , R. Vengust, R. Košak, M. Gorenšek (SLOVENIA)
12:05	12:15	LUMBOISCHIALGIC PAIN AS A RESULT OF CAUDA EQUINA ABSCESS: A REPORT OF A CASE <u>T. Velnar</u> , <u>G. Bunc</u> (SLOVENIA)
12:15	12:25	ROLE OF THE FDG PET/CT SCAN IN A DIAGNOSTIC - THERAPEUTIC ALGORITHM FOR SPINE INFECTIONS <u>L. Boriani</u> , C. Nanni, A. Gasbarrini, M. Comisso, A. Villaminar, M. Balsano (ITALY)
12:25	13:30	LUNCH
13:30	16:00	SURGICAL TREATMENT OF SPINE TUMORS Chairs: D. Jeszenszky, P. P. Varga
13:30	13:50	SURGICAL TREATMENT OF HIGH CERVICAL TUMORS D. Jeszenszky (SWITZERLAND)
13:50	14:10	SURGERY OF THE PRIMARY SACRAL TUMORS P. Varga (HUNGARY)
14:10	14:30	SURGICAL TREATMENT OF PRIMARY AND METASTATIC SPINAL TUMORS <u>J. Saveski</u> , N. Trajkovska, I. Hasani, I. Kaftandziev (REPUBLIC OF MACEDONIA)
14:30	14:50	BALLOON KYPHOPLASTY IN NEOPLASTIC LESIONS OF THE SPINE E. Sucher (ISRAEL)
14:50	15:00	SURGICAL TECHNIQUE FOR PANCOAST TUMOR RADICAL RESECTION U. Aydinli (TURKEY)
15:00	15:10	PRIMARY MALIGNANT SPINAL CORD TUMORS - IMPACT OF EXTENT OF SURGICAL RESECTION ON OVERALL SURVIVAL <u>M. Vukić</u> , S. Marasanov, M. Rožanković (CROATIA)
15:10	15:20	USE OF THE O-ARM SYSTEM IN OPERATIVE CORRECTION OF CRANIOCERVICAL, ATLANTOAXIAL AND HIGH CERVICAL INSTABILITY IN PATIENTS WITH BENIGN AND MALIGNANT LESIONS <u>N. Mirchev</u> , F. Gamm, R. Behr (GERMANY)
15:20	15:30	LANGERHANS' CELL HISTIOCYTOSIS OF THE SPINE: ANALYSIS OF 11 CASES <u>S. Miličković</u> , B. Jesic, O. Krneta, D. Dozić, Z. Poleksić, V. Lalošević (SERBIA)
15:30	15:40	LUMBAR SPINE EPENDIMOMA MIMICKING STRESS INCONTINENCE - CASE REPORT <u>V. Lalošević</u> , B. Djurović, Z. Poleksić, S. Miličković, D. Dozić, M. Aleksić (SERBIA)
15:40	15:50	GCT OF THE SACRUM, SERIES OF 8 CASES <u>Z. Szoverfi</u> , A. Lazary, A. Bozsodi, P. Varga (HUNGARY)
15:50	16:00	WOUND HEALING COMPLICATIONS OF SACRAL CHORDOMA RESECTIONS IN ELDERLY <u>Z. Szoverfi</u> , A. Lazary, I. B. Bors, P. Varga (HUNGARY)
16:00	16:20	CLOSING REMARKS
16:20	16:40	SEG COUNTRY REPRESENTATIVES MEETING
16:40		ADJURN

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REGISTRATION AND FEES

Registration Fees

SEG 2012	LATE RATE Payment after October 30, 2012
Participants from all countries involved in SEG (Bosnia-Herzegovina, Bulgaria, Croatia, Greece, Hungary, Kosovo, FYR-Macedonia, Montenegro, Romania, Serbia, Slovenia, Turkey)	free
Registration fee Non Spine Experts Group Member	EUR 300
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The congress fees include

- Participation in all lectures and access to the exhibition area
- Congress bag including programme with abstracts
- Admission to Conference Dinner
- Coffee at the exhibition area during the breaks
- Working lunches

SOCIAL PROGRAM

Thursday, November 29, 2012

20.00-24.00 CONFERENCE DINNER/ CD Club, Cankarjev dom, Cultural and Congress Center
Included in the participants' fee.

GENERAL INFORMATION

Coffee breaks

During session breaks, refreshments will be served free of charge to participants wearing congress badges.

Lunches

Working lunches are included in the registration fee and will be served during lunch time in Foyer II.

Official language

The official language of the Symposium is English.

Registration and Information Desk

The Registration Desk for the SEG Symposium, located in Foyer II of Cankarjev dom, will open as follows:

Wednesday, November 28	17.00 – 19.00
Thursday, November 29	8.00 – 19.00
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A conference identification badge will be included in the conference material provided upon registration. There will be no admittance to the scientific sessions without the conference badge.

Attendance Certificate

A Certificate of Attendance will be issued to all registered participants.

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***INSTRUMENTATION
IN
DEGENERATIVE SPINE DISORDERS***

THE CORRELATION BETWEEN SPINAL DECOMPRESSION AND PATIENT OUTCOME

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Introduction

Lumbar spinal stenosis is a debilitating clinical condition caused by the narrowing of the spinal canal with diminished space available for neurovascular components. It is the most common indication for spinal surgery among patients older than 65 years. Although symptoms associated with spinal stenosis are well known to clinicians, there is no agreement on radiological criteria to define stenosis. Authors use different anatomical landmarks and cut-off values when referring to canal narrowing. It is a general and reasonable assumption that surgical decompression of the neural elements will provide symptomatic relief for spinal stenosis patients. However, radiological proof of decompression and patient outcomes do not always correlate. Main aim of this study is to investigate the correlation between spinal canal decompression and patient outcome by investigating three different parameters of canal dimensions.

Materials and methods

This retrospective case control study was performed on 16 patients who were operated by the same senior spine surgeon. All the patients had symptoms of disabling leg pain or claudication and were diagnosed with lumbar spinal stenosis based on MRI findings. Radiological criteria for diagnosis of lumbar spinal stenosis was to have AP diameter of less than 10 mm at least in one level or to have dural sac area of less than 70 mm². All the patients answered the validated Turkish translation of the ODI questionnaire prior to surgery. All the patients underwent central laminectomy extended laterally and facetectomy with posterior instrumentation and fusion. Minimum cross-sectional area of the dural sac, AP and transverse diameter were measured. All the measurements were made using the software/work station. For statistical analysis, SPSS 12.0 was used. Preoperative and postoperative spinal canal dimensions and ODI scores were assessed using the Wilcoxon test. The Pearson correlation between the change in canal dimensions and change in ODI scores was calculated. For multivariate analysis with normal spinal canal dimension of uninvolved segment as a covariate, MANCOVA (Multivariate Analysis of Covariance) was used. $p < 0.05$ was considered significant.

Results

Mean preoperative and postoperative spinal canal dimensions and self-assessment scores are outlined on table 1. Decompression of all of the spinal canal dimensions was statistically significant. ODI scores revealed statistically significant improvement of patient outcome. Only change in transverse diameter of the spinal canal showed a significant correlation with improved ODI scores. This correlation still existed after multivariate analysis with regard to normal canal dimensions were made.

Table 1

	AP DIAMETER	TRANSVERSE DIAMETER	CROSS-SECTIONAL DIAMETER	ODI
PREOPERATIVE	9.0	11.2	68.5	65.9
POSTOPERATIVE	15.8	17.3	187.7	22.2
	P<0.05	P<0.05	P<0.05	P<0.05

Conclusion

Although symptoms associated with spinal stenosis are well known to clinicians, there is no agreement on radiological criteria to define stenosis. AP diameter defined by Veridest and cross sectional area of the dural sac remain the most widely used criteria when defining central spinal stenosis. Transvers diameter is an overlooked parameter. In this study, we evaluated the spinal canal by measuring AP and transvers diameter of the dural sac, minimum dural sac area. One advantage of this study is that it evaluates the degree of decompression quantitatively, not referring to cut-off values with poor clinical correlation. There was a significant improvement in patient outcome following decompression surgery. Decompression of the dural sac area and AP diameter did not result in improved patient outcome. However, there was a significant correlation between patient outcomes and decompression in transverse diameter, which is an overlooked parameter. Decompression of the transvers diameter of the spinal canal is related to improved patient outcome following spinal stenosis surgery.

This overlooked parameter needs to be assessed carefully with further studies. Effect of transvers diameter on preoperative neurogenic symptoms and its relation with patient assessment is also necessary. It is possible that main reason of discordance between radiological findings and neurogenic symptoms may be that authors were looking at the wrong place when defining stenosis. Results of this study may help identify predictive factors for surgical management and help to define radiological stenosis precisely.

TWO LEVEL AXIALIF ANTERIOR FUSION

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Abstract:

Anterior lumbosacral fusion is traditionally associated with a high complication rate. Mininvasive surgery had started mainly with posterior approaches and only few anterior fusion techniques are today considered mininvasive. Axialif procedure through a presacral trajectory is safe and effective. A preliminary short retrospective study of the two level axialif L4-L5-S1 documents the indications, describes the procedure, illustrates the cases and lists the preliminary results.

Fifteen cases are illustrated concerning pathologies as pseudoarthrosis/ revisions, two level degenerative disc disease, spondylolisthesis, scoliosis. In all cases posterior transpedicular screws are added for the 360° fusion. In two cases anterior procedure was performed first while in all the other cases lumbar lordosis was first gained posteriorly and the axialif procedure followed. Also the position of the axialif screw with respect to the pedicle screws was evaluated.

In a up to two year follow up no serious complications were found and both radiological and clinical results are satisfactory.

Within correct indications and a careful performance of the presacral procedure, two level axialif appears to be an effective device for anterior l4-s1 mininvasive fusion.

OPERATIVE TREATMENT OF LUMBAR SPINE SPONDYLOLISTHESIS

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Abstract:

Management of degenerative lumbosacral spondylolisthesis with spinal stenosis is still controversial. Surgery is widely used, as well as non-surgical treatment.

Aims

To evaluate the clinical results and functional outcome after operative treatment in Grade II and III lumbar spine spondylolisthesis.

Materials and methods

Twelve patients with symptoms and image-confirmed degenerative spondylolisthesis entered the study. Mean patient age was 57 years. Spondylolisthesis Grade II or III, segment L4-L5 or L5-S1 were evaluated. All patients underwent similar protocols. Operative treatment was decompressive laminectomy, posterior one segment fixation and fusion with autologous bone grafting. Functional outcome measures were Visual Analog Scale (VAS, 10-point scale) and Oswestry Disability Index (ODI, 100-percent scale) after 6 and 12 months.

Results

Patient follow-up was 12 months. Preoperatively, 7 patients had severe disability according to ODI, 4 had moderate disability. VAS measured 6 and 7 points in 6 patients, lowest score of 4 points and the highest score of 9. After 6 months, ODI showed 5 patients had minimal and 7 had moderate disability; 2 patients had 0 points on the VAS, 2 had a score of 1, 4 had a score of 2, highest score of 4 points. Treatment outcome effects after 1 year were 9 patients with minimal disability, 3 with moderate; VAS - 2 patients with 0 points, 3 with 1 point, 4 with 2 points.

Conclusion

Patients with degenerative spondylolisthesis and spinal stenosis treated surgically showed substantially greater improvement in pain and functional outcome during a period of 1 year.

RESULTS OF TREATMENT OF DEGENERATIVE LUMBAR SPINAL STENOSIS (DLSS) WITH THE ADJUNCT OF INTERSPINOUS PROCESS DEVICES TO SURGICAL DECOMPRESSION

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The interspinous process devices (IPD) act by the principle of indirect decompression by distraction which is accomplished by limitation of lumbar extension, increasing the interlaminar space, and stretching of the infolded ligamentum flavum. By decompressing neural structures, adjunct IPD implantation might minimize the invasiveness of decompressive surgery by lessening the amount of tissue needing to be resected.

This study analyzed the success rates of 25 DLSS patients treated with decompressive surgery with additional DIAM implantation (DIAM group). Outcomes were measured with VAS for back and leg pain, the Oswestry Disability Index (ODI), and the Zurich Claudication Questionnaire (ZCQ). The results were compared to a historic group of DLSS patients treated with decompression only (Decompression group, N=38), and decompression with addition of standard posterolateral instrumented fusion (Fusion group, N=20).

The DIAM group included 12 males and 13 females, and the mean age was 64.5 years (range, 42-83 years). At the 24-months follow-up the mean VAS and ODI dropped significantly (from 7.0 to 5.3 for back pain, from 7.3 to 4.9 for leg pain, and ODI from 61 to 39, respectively). Comparatively, the overall success rate was 63.6% for the DIAM group, 57.9% for the Decompression group, and 75.0% for the Fusion group; the differences between the groups were not significant. However, the operative time and blood loss were significantly reduced in the DIAM group (89 min/265 ml for the DIAM, 128 min/742 ml for the Decompression, and 217 min/1505 ml for the Fusion group, respectively), and the same was true for the length of narcotic analgesics use and the length of hospital stay (2.3/6.3 days for the DIAM, 3.9/8.1 days for the Decompression, and 6.2/13.1 days for the Fusion group, respectively).

The aid of adjunct IPD to the operative decompression of the lumbar spine offers significant improvement for patients with DLSS.

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- [1] S.K. Fokter, S. A. Yerby, "Patient-based outcomes for the operative treatment of degenerative lumbar spinal stenosis," *Eur. Spine J.*, vol. 15, pp. 1661-1669, 2006.
- [2] Richter, C. Schutz, M. Hauck, and H. Helm, "Does an interspinous device (Coflex™) improve the outcome of decompressive surgery in lumbar spinal stenosis? One-year follow up of a prospective case control study of 60 patients," *Eur. Spine J.*, vol. 19, pp. 283-289, 2010.

PEDICLE SCREW PLACEMENT IN L/S SPINE USING RAPID PROTOTYPING DRILL GUIDE TEMPLATE

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Abstract:

The method of pedicle screw placement is generally safe although it carries some risks connected with accurate screw placement. For this reason, we can find on the market many computer-assisted systems that are highly accurate. However, these devices have some disadvantages. We have developed a method of pedicle screw placement in L/S region using multi-level drill guide template, created with rapid prototyping technique and have validated it in a clinical study.

Aim

Comparing accuracy of pedicle screw placement using a drill guide template and a free-hand technique under fluoroscopy supervision.

Materials and methods

We have randomly chosen 20 patients (62 screws for trial and 54 for control group) that were planned for L/S fusion on different levels. A CT scan was performed for desired region. Afterwards a 3D reconstruction model of spine was generated and optimal screw position and a drill guide were designed. The templates were manufactured using selective laser sintering technology. Afterwards a postoperative CT scan and analysis were performed.

Results

Incidence of perforation of the pedicle cortex was significantly lower in trial group, also the deviation level of the screws in sagittal plane. Screw length and the duration of the procedure were not significantly different.

Conclusions

The method lowers the incidence of the pedicle perforation and is therefore promising although some caveats remain.

References:

- [1] Lu S, Xu YQ, Zhang YZ, Li YB, Xie L, Shi JH et al. A novel computer-assisted drill guide template for lumbar pedicle screw placement: A cadaveric and clinical study. Int J Med Robot 2009; 5 Suppl 2: 184–191.

***MISS/LISS
AND
MOTION PRESERVATION TECHNOLOGY***

MISS/LISS IN DEGENERATIVE CONDITIONS: CURRENT TRENDS

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Bern, Switzerland

The definition of MISS/LISS is based on identifying the common goals and principles of MIS surgery- a MIS procedure is one that by virtue of the extent and means of surgical technique results in less collateral tissue damage, resulting in measurable decrease in morbidity and more rapid functional recovery than traditional exposures,

without differentiation in the intended surgical goal.” (McAfee) The justification of a procedure as “MIS” includes (1) reduced surgically induced tissue damage; (2) measurable clinical benefits such as lower blood loss, reduced surgical morbidity, reduced postoperative analgesic requirements, reduced length of hospitalization, and early resumption of activities; (3) clinical effectiveness; and (4) a favorable socioeconomic effect.

MISS / LISS is dependent from specific technology –specific retractor systems, special instruments, special implants, fusion material independent from the shelf and auxiliary tools like endoscopic and optical technology for better visualization and illumination and under certain circumstances robotic/navigation technology. What is considered MISS/LISS compared to a “traditional” exposure? In reality, there is not just a single MIS procedure, but rather various gradations of surgical exposures, including what is commonly referred to as “mini-open,” “tubular,” “percutaneous,” or even combined approaches. All of these approaches represent an attempt to minimize surgically induced tissue damage. Unfortunately there is no good controlled, prospective randomized clinical study which compares standardized procedures in so called traditional technique and in MISS/LISS technique. Most of the publications are surgeon based who proposes a specific surgical procedure, which works well in the hand of this specific surgeon. There is e.g. no study investigating the rate of non-unions in minimally invasive TLIFs, where no formal fusion is made and also the intervertebral space is not thoroughly cleaned out and filled with bone. More and more it seems that so called “minimized” classical procedures are abandoned again for the sake of traditional surgery and that only MISS/LISS surgeries which have been designed as such

(XLIF, ALIF) are going to survive as a standardized frequently used procedure. It seems that in a longterm it does not really matter, whether a pedicle screw is applied with a LISS/MISS technique or with a soft tissue preserving “traditional” technique, specifically when the MISS technique is going to take more OR time and therefore longer operating theatre and personnel utilization and consequently increased costs.

**TOTAL DISC ENDOPROTHESIS OF THE CERVICAL SPINE:
PEEK VS METAL**

T. Friesem

DISCOVER TOTAL CERVICAL DISC ARTHROPLASTY IN SURGICAL TREATMENT OF A SINGLE LEVEL CERVICAL DISC DISEASE

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Aims

Total cervical disc arthroplasty is an emerging surgical treatment option for selected patients with a single level cervical disc disease in the last decade. Anterior cervical discectomy and fusion is still the „gold standard“ for those patients but the total cervical disc arthroplasty offers several advantages over it in selected patients and the main is preserved range of motion at the treated level preventing the adjacent disc disease.

Materials and methods

Seventy patients with a single level cervical disc disease who met the inclusion criteria were treated with total cervical disc arthroplasty using Discover artificial disc. All patients were evaluated with pre- and postoperative serial radiographic studies (MRI, standard and functional cervical spine Xrays), and clinically, using The Neck Disability Index (NDI), Visual Analog Scale (VAS) and neurological status at 3, 6, 12 and 24 months, respectively.

Results

The results of our study indicate that cervical arthroplasty using Discover Artificial Disc provides excellent clinical and radiological outcomes in follow up period of 24 months. There has been significant improvement in clinical parameters, VAS and NDI, at 3, 6, 12 and 24 months. During the follow – up period six of our patients developed heterotopic ossification with complete loss of range of motion at the treated level (8,5%), which had no influence on the clinical outcome, and we had one patient with the prosthesis migration who needed to be reoperated. There were no other major surgery related complications.

Conclusion

The Discover artificial cervical disc replacement offers excellent outcome for a single level cervical disc disease in selected patients at short- and long-term follow-up.

SINGLE - AND MULTI-LEVEL CERVICAL ARTHROPLASTY: COMPARISON OF CLINICAL AND RADIOLOGICAL OUTCOMES 5 YEARS AFTER CERVICAL DISC REPLACEMENT WITH PRODISC-C PROSTHESIS

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Aim of the study:

Disc arthroplasty preserving the segmental motion and improving load transfer to the adjacent levels has been increasingly used for the treatment of cervical degenerative disc disease in recent years. The role of disc arthroplasty on the adjacent-segment degeneration and the degree of heterotopic ossification (HO) of the treated segment remain the subject of discussion.

The aim of the study was to assess clinical results and the radiographic outcomes following insertion of the ProDisc-C prostheses in patients treated for symptomatic cervical degenerative disc disease, with an emphasis on the degree of HO of the treated segment and the range of motion of the operated, as well as the adjacent segments five years after the surgery.

Methods:

Twenty patients with soft disc cervical herniations were treated with complete anterior cervical discectomy and ProDisc-C disc arthroplasty. Overall 13 single, 5 two- and 2 three-level procedures were performed. Comparison between both groups (single and multi-level group) was based on clinical outcomes using neurological examination, visual analogue scale (VAS), Neck Disability Index (NDI) and patient's satisfaction. Preoperative and postoperative disc heights and ROMs were evaluated radiographically by measuring the lateral and flexion-extension radiographs. Computed tomography was used pre and postoperatively to measure the extent of HO.

Results

Both groups had a statistically significant improvement in NDI and VAS for neck and arm pain ($P < .05$), 5 years after the surgery and there were no significant differences between the groups at any point of evaluation (that is, at 12, 36 and 60 months after surgery). Heterotopic ossification was identified more frequently in the multi-level group than the single-level group (72.0% vs. 42.3%). At the 5-year follow-up, there were significantly more patients in the multi-level group with severe adjacent-level radiographic changes.

Conclusions:

ProDisc C is effective cervical spine disc prosthesis preserving segmental motion after surgery and providing improvement in pain and functional outcome for the patients. Clinical outcomes of single- and multi-level cervical arthroplasty were similar at 60 months after surgery, and patients in both groups had significantly improved compared with preoperative results. However, there was a significantly higher rate of heterotopic ossification formation and less mobility of the artificial discs in the patients who underwent multi-level procedure.

**PARTIAL DISC ENDOPROSTHESIS OF LUMBAR SPINE: A
NEW TREATMENT OPTION**

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THE INFLUENCE OF TOTAL DISC ARTHROPLASTY WITH MOBIDISC PROSTHESIS ON LUMBAR SPINE AND PELVIC PARAMETERS – PROSPECTIVE IN VIVO BIOMECHANICAL STUDY WITH A 3 YEAR OF FOLLOW

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Aims

The aim of this prospective in vivo study is to analyze effects of TDA with a Mobidisc prosthesis on biomechanical parameters of lumbar spine and pelvis in patients operated due to degenerative disc disease (DDD).

Materials and method:

We prospectively analyzed x rays of 63 patients among of total 80 patients with DDD in which TDA at one level were performed between January 2005 to December 2008 in Hopital Civil, Strasbourg. Standard lateral dynamic x rays (flexion and extension) and standing lateral full spine x rays has been done before surgery and at 6, 12 and 36 months after the surgeries. Following parameters were analyzed before and after the surgery: range of motion (ROM), vertebral translation, lumbar lordosis (L1-S1), intervertebral angle, anterior and posterior disc height, sacral slope, pelvic tilt and pelvic incidence.

Results

Mean follow-up time was 44 months. 45 female and 18 male patients with a mean age of 42,1 year were evaluated. TDA was performed at L4/L5 in 18 (29%) and L5-S1 in 45 patients (71%). Range of motion (ROM) improved significantly at both level, at L4-L5 for 6,7° and at L5-S1 for 6,3° compared to preoperative findings. Overall mobility after 3 year was 10,5° for L4/L5 and 7° for L5/S1 level. There were no significant changes in translation at both level, not in flexion not in extension. Intervertebral angle, lumbar lordosis and disc height significantly improved for both levels (P < 0,001). Preoperative disc height didn't have influence on postoperative L5/S1 mobility (P = 0,375), but had on mobility L4/L5 (P = 0,01). Sacral slope has improved significantly only for L5/S1 level (P<0,001) without significant consequences to other sagittal parameters, pelvic tilt and pelvic incidence. There were no statistical differences at final results between males and females.

Conclusion

Mobidisc lumbar disc prosthesis improved significantly range of motion, lumbar lordosis and disc height at implanted level of L4/L5 or L5/S1 in patients operated due to DDD. TDA with Mobidisc have no influence on spinopelvic sagittal parameters.

PERCUTANEOUS INSTRUMENTATION WITH INDIRECT NEUROFORAMINAL DECOMPRESSION FOR LOW-GRADE ISTHMIC SPONDYLOLISTHESIS WITH RADICULOPATHY

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Abstract

Isthmic spondylolisthesis mostly affects lumbosacral junction with reported incidence of 4-6 percent. The mainstay of surgical treatment is instrumented fusion with decompression of L5 foramina in cases of radiculopathy. The aim of present report is to present novel surgical technique for isthmic spondylolisthesis with radiculopathy consisting of percutaneous posterior and anterior instrumentation enabling indirect distraction of neuroforamina.

Five patients were operated for L5S1 low-grade isthmic spondylolisthesis employing percutaneous pedicular fixation and axial lumbar interbody fusion. All patients had L5 foraminal stenosis with signs of radiculopathy. Follow-up was one year with outcome measures being ODI and VAS for back and leg. Pre and postoperative segmental lordosis, percentage of slip and segmental distraction were recorded.

Mean time of surgery was 115 minutes (105-140). There were no intraoperative complications; one patient died three weeks after surgery because of pulmonary embolism. ODI dropped from 69 to 44 after surgery. VAS back dropped sharply from 7.0 to 2.5 and VAS leg from 7.5 to 6.2. Segmental lordosis remained unchanged with surgery (21 degrees) while intervertebral disc height increased from 9.3 to 11.5 millimeters. There was on average 18 percent of slip reduction with surgery. A patient with most distraction (4.0 millimeters) required open L5 foraminotomy due to leg pain, which intensified two months after index surgery, another patients leg pain (distraction of 3.4 millimeters) was successfully managed with two consecutive L5 root blocks.

Percutaneous pedicular fixation with axial interbody instrumented fusion poses an alternative to standard procedures for low grade isthmic spondylolisthesis. Segmental over distraction should be avoided in order to preclude postoperative L5 irritation.

EARLY ADVANTAGES OF MINIMALLY INVASIVE VERSUS OPEN TRANSFORAMINAL LUMBAR INTERBODY FUSION

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Aims

Minimally incision techniques of lumbar interbody fusion have been in recent years gaining popularity among spine surgeons due to their less invasive approach. Our study has been conducted with the purpose to quantify possible advantages of a minimally invasive TLIF (MIS-TLIF) over an open TLIF procedure.

Subjects and methods

Twenty-seven patients were recruited into this prospective study since January 2012 until August 2012. Only patients with single or two-level fusions were considered for inclusion in the survey. An open TLIF procedure was performed in 11 subjects with mean age 56.4 years. MIS-TLIF was used in 16 subjects with mean age 53.2 years. Amount of blood loss, muscle damage, postoperative pain and speed of early rehabilitation were recorded and compared between the two groups.

Results

Lower blood loss was observed in a group with MIS-TLIF during the operation (187 ml vs. 476 ml) and after the procedure (71 ml vs. 463 ml). Higher increase in creatine kinase levels, suggesting more muscle damage, was recorded in the open TLIF group (29 mg/L vs. 13 mg/L). Less pain was reported postoperatively on the visual analogue scale by patients in the MIS-TLIF group (4.8 vs. 5.8). Subjects in the open TLIF group left the hospital on average 2 days later (6th vs. 4th day).

Conclusions

Early advantages of minimally invasive spine procedures include less muscle damage, less blood loss, less postoperative pain and faster early rehabilitation. Any advantages that these procedures might bring in the later rehabilitation period have not been documented to date and remain a focus of research.

**FORAMINAL DECOMPRESSION AND MINIMALLY INVASIVE
INTERSPINAL STABILIZATION IN DEGENERATIVE LUMBAR
STENOSIS- INDICATIONS, SURGICAL TECHNIQUE AND
EARLY RESULTS.**

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Exhibited indications and technique of foraminal decompression and interspinal stabilization of degenerative stenosis in distal lumbar spine of 27 patients for a period of one year. The surgical options and the amount of tissue resection during paraneural decompression and consistency of operational gestures in placing the implant are described. Assessment of cases was made on clinical and imaging diagnostic criteria. The clinical include neurological status, volume and freedom of movement in the lumbar spine, postoperative period, and the extent and time of recovery of work capacity. Imaging and diagnostic criteria are implant position at movement of the spine in all three planes, intervertebral relationships and bone structure in the zone of contact with the implant. The discussion is a comparison between this method and treatment with orthosis and monosegment stabilization with transpedicular screws for more than twenty five years of experience. Early results are encouraged to the relatively high stability of the segment with minimal invasiveness of the procedure and keeping decompressed paraneural area.

EARLY BALLOON KYPHOPLASTY IN FRAGILITY VERTEBRAL COMPRESSION FRACTURES INFLUENCES QUALITY OF LIFE

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Aims

Early balloon kyphoplasty (BKPL) in fragility vertebral compression fractures remains controversial. Majority of authors recommend BKPL as useful painkilling procedure when intractable pain sustains for more than three weeks. Authors report on significant connection between early BKPL and quality of life of elderly patients when no neurological deficit and/or spinal stenosis is detected on preoperative radiographs and MRI.

Materials and methods

129 one or two segment BKPL were performed in GHT Celje since the introduction of the method in 2004. Cases with BKPL and concomitant posterior instrumentation were excluded. All the patients with VCF in thoracolumbal segment were diagnosed with standard radiography and MRI preoperatively. The influence of BKPL on pain, mobility, Oswestry questionnaire and SF12 were measured.

Results

Pain assessment (VAS): 56% <2, 11% 3-4, 22% 5-8, 11% 9-12. No VAS >12 (severe pain) was obtained.

Mobility: no disability 44%, minimal disability 22%, mild disability 33%. No severe disability was obtained.

Oswestry low back pain disability questionnaire: minimal disability 78%, moderate disability 22%. No severe disability was obtained.

SF12 (Short Form 12) Health Survey: physical health subscore 14.9 (73%), emotional health subscore 22.3 (82%). Total score 37.2 (79%).

Conclusion

BKPL represents minimal invasive surgery without major complications, prompt pain relief with early return to daily activities as before the fracture. Authors recommend early BKPL in patients with osteoporosis when low energy VCF is not connected with neurological deficit and spinal stenosis. MRI is obligatory before surgery.

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OPTIMAL CEMENT VOLUME FOR VERTEBROPLASTY – BIOMECHANICAL STUDY

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Aims

Vertebral augmentation techniques for osteoporotic vertebral fractures have gained wide popularity in recent years. Cement leakage and adjacent vertebral fracture are main problems of vertebroplasty and they are both connected to volume of cement injected. There is still no clear cut data on amount of cement volume to be injected. The aim of present biomechanical cadaveric study was therefore to determine optimum percentage of cement fill volume.

Methods

Thirteen thoracolumbar spine segments (two adjacent vertebrae with intervening intervertebral disc and ligaments) from 8 cadavers (72 - 83 years) were used. They were loaded to induce vertebral fracture. After fracture vertebroplasty was performed consecutively using 5%, 10%, 15% and 20% of volume of fractured vertebra. Vertebral volume was measured before and after fracture using dedicated three-dimensional (3D) model automatically aligned with the vertebral body in CT image. Biomechanical testing (compressive stiffness and intradiscal pressure) was performed before and after the fracture and after each cement injection.

Results

Compressive stiffness was reduced after vertebral fracture for 47% and was partially restored to 63% of prefracture value after 10% cement fill. There was no substantial increase of compressive stiffness in larger fill volumes. Intradiscal pressure fell for 48% to 59% after fracture depending on specimen position. With vertebroplasty it gradually increased to total of 55%-70% at 15% of cement fill with no further increase with larger volume.

Conclusions

Compressive stiffness and intradiscal pressure increase with percentage of cement fill. Fifteen percent of cement fill was the limit beyond which no substantial increase in compressive stiffness and intradiscal pressure was detected.

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BALLOON KYPHOPLASTY IN TRAUMATIC FRACTURES OF THE THORACOLUMBAR SPINE AS STANDALONE TECHNIQUE OR COMBINED WITH POSTERIOR STABILIZATION TECHNIQUES

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The most popular technique to reduce and fixate traumatic thoracolumbar fractures is the posterior short segment instrumentation with pedicle screws, due to the relatively simple procedure, the favorable clinical outcome, and the low complication rate. A recognized disadvantage of the posterior approach is the difficulty in restoring the anterior column. Anterior techniques have been demonstrated to be demanding on patients and surgeons and are often complicated by considerable postoperative comorbidity. It was suggested that balloon vertebroplasty could play a role in restoring and augmenting traumatic vertebral body fractures without or after pedicle screw instrumentation, since the balloons could be used to reduce the fractured endplates, thereby restoring the boundaries of the intervertebral disc space.

In this presentation the first clinical results are discussed. In group of non-osteoporotic patients with type A fractures treated with balloon kyphoplasty as standalone technique vertebral body height, Cobb angle, visual analogue pain scale, complication rate and patient quality of life were measured one year after surgery.

In group of patients with Type B and C fractures treated by combined techniques vertebral body height, Cobb angle, visual analogue pain scale, complication rate and patient quality of life were measured one year after surgery.

We conclude that presented techniques are an effective, alternative, simple and safe treatment of traumatic fracture of the thoracolumbar junction.

MINIMALLY INVASIVE POSTERIOR STABILIZATION OF THORACOLUMBAR SPINE FRACTURES

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Aim

Minimally invasive techniques are gaining popularity among spinal surgeons. In 2011 we started performing minimally invasive posterior technique in stabilising thoracic fractures and instabilities.

Methods

We retrospectively evaluated 40 of our 56 patients operated with this technique from June 2011 to September 2012. They were stabilized because of instabilities which originated from trauma, ankylosing spondylitis or metastatic tumors.

We monitored mean operation time, mean blood loss, postoperative pain and rehabilitation.

Results

Mean operation time was 101,34 min (60 min – 262 min). Mean operation blood loss was 343,75 ml (100ml – 1200 ml). The operation time and blood loss were significantly higher in tumour patients, where we typically performed laminectomy and anterior support with bone cement in addition to posterior stabilization. These results are similar to that from other articles.

Conclusion

We find this method very useful especially in multi-level stabilization cases, in patients with poorer general condition and in palliative metastatic disease stabilization . The operation time was shorter than in open procedures, the blood loss was minimized, postoperative pain was reduced and rehabilitation time was shortened.

***MANAGEMENT
OF
SAGITTAL BALANCE DISORDERS
AND
SCOLIOSIS***

SPINOPELVIC SAGITTAL BALANCE: BASIC PRINCIPLES

D. Chopin

**IMPACT OF SAGITTAL BALANCE ON SURGICAL TREATMENT
OF DEGENERATIVE SPONDYLOLISTHESIS AND
DEGENERATIVE SCOLIOSIS**

D. Chopin

SPINAL DEFORMITIES IN CHILDREN AND COMPETITIVE SPORT

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The aim of this retrospective study was to determine the importance and impact of competitive sport activities in children with spine deformities undergoing an orthopaedic treatment.

The study population was divided into two groups.

First group consisted of 43 patients treated between 1984. and 1998, while the second group included 31 patient treated between 1999. and 2009, with different spine deformities.

All the patients were children of 9 to 18 years of age (mean 13.5) treated and followed on in our practice in Spinal Center of Institute „Banjica“, Belgrade.

Spinal deformities were classified according to the etiology and type of the deformity.

All the patients were actively involved in competitive sports, either on school or national level, as members of different teams.

Sport activities and competition did not influence orthopedic treatment of spine deformities.

Children involved in the study proved to be more satisfied with their final outcome at the end of the treatment

ANALYSIS OF OUTCOME OF SCOLIOSIS OPERATIVE TREATMENT FROM JANUARY 2000 TO DECEMBER 2010 IN VALDOLTRA ORTHOPAEDIC HOSPITAL

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Introduction

The objective of the study was to perform retrospective analysis of treatment of different types of scoliosis as a function of type of operative treatment, sub-diagnosis and type of curvature single instrumented curvature and double instrumented curvature.

Methods

From January 2000 to December 2010 326 operations due to various type of scoliosis were performed at our hospital. The cohort of patients was divided according to the primary diagnosis to the following groups: idiopathic scoliosis (N=251, 77%), neuromuscular scoliosis (N=22, 7%), adult degenerative scoliosis (N=29, 9%), congenital scoliosis (N=16, 5%), posttraumatic scoliosis (N=4, 1%) and neurofibromatosis (N=2, <1%). The main group of patients with idiopathic scoliosis was divided according to age of patients at the time of deformation to: infantile (N=3), juvenile (N=59) and adolescent (N=189). In addition, we divided the idiopathic scoliosis according to the number of curves on an instrumented single- and double instrumented scoliosis. We split them by number of operations performed on each patient. We analysed the radiological parameters before and after surgery: the possibility of correction before surgery, then postoperative angles and the percentage of correction and then a final correction post-operatively at the time of control visit. We divided the patients with idiopathic scoliosis in those who underwent double surgery (anterior and posterior approach) - 33 patients, and those who underwent surgery by posterior approach only. Results of these groups were also analysed. Regarding to objectivity we took out from the group of patients who underwent only posterior surgery those with curvature greater than 60 degrees (80 patients). This group was compared separately with a group of patients who underwent double surgery. The average values were determined for each group. Further, data regarding the complications, duration of operation, blood loss and duration of hospitalization were collected.

Results

Among 251 patients with idiopathic scoliosis, 218 were operated by posterior approach. The average age was 14,9 years, 178 were female and 31 male. The average follow-up was 3 years. Among 218 patients, 173 were diagnosed for adolescent scoliosis, 95 for single instrumented curvature and 78 for double instrumented curvature, 44 patients were diagnosed for juvenile scoliosis, 25 for single instrumented and 19 for double instrumented curvature. Among 251 patients with idiopathic scoliosis, 33 were operated the combined method: anterior approach (thoracotomy and discectomy then the posterior approach to correction and fusion). The average age of this group was 13.5 years, 29 girls and 4 boys. Average follow up in this group was 4.3 years, in group of 33, 15 patients with adolescent idiopathic scoliosis were operated on single curve, and 1 on double curve. Of the remaining 17, 12 juvenile idiopathic scoliosis were instrumented on single curves, and 3 on double. In the same group 2 girls were operated for single idiopathic infantile scoliosis. The following radiographic data were obtained for the

whole cohort of patients of idiopathic scoliosis: average initial angles 52,9° for thoracic (T), 55,9° for thoracolumbar (THL) and 48,7° for lumbar (L) curve, with the following average postoperative corrections: 70% for T, 71% for THL and 67% for L. At the last control visit the average decrease in correction was as follows: 13,7% for T, 15,5% for THL and 12,9% for L. We found the spontaneous correction of noninstrumented curves in the group of patients with single instrumented curve, except in three cases. In these three we obtained another operation because of worsening of noninstrumented lumbar curve. Comparing the success of the correction between the group of patients with idiopathic scoliosis who underwent double surgery (anterior and posterior approach) and a group of patients with a curvature greater than 60 degrees who underwent posterior surgery, showed no significant difference. Data were further analysed separately for each sub-group.

Discussion

The results of two operative treatments of scoliosis as a complex three dimensional deformity were analysed retrospectively in a relatively large cohort of patients. Significant improvement reaching up to 70% was achieved by both treatments. Data in each subgroup will be compared and be discussed in terms of advantages and disadvantages of particular type of operative approaches.

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DUAL GROWING ROD TECHNIQUE IN EARLY ONSET SCOLIOSIS

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Aims

Growing rod surgery is a modern alternative treatment for young children with early onset scoliosis (EOS). This study was performed to evaluate patients treated with dual growing rod technique.

Materials and methods

A total of 7 consecutive patients (5 male, 2 female) were analyzed. We analyzed demographic and radiographic data including age, etiology, comorbidity, initial Cobb angle, last follow-up curve magnitude, duration of follow-up, instrumented vertebral levels per patient, surgical procedures per patient, lengthening procedures per patient, duration between growing-rod lengthening procedures, unplanned surgical fusion, patients with final fusion, complications (wound, implant, alignment and general surgical or medical).

Results

The mean age at the initial surgery was 5 years (3-10). Etiologies were idiopathic in 3 patients, congenital kyphoscoliosis in 1 patient, neurofibromatosis (NF) type 1 in 1 patient, neuromuscular in 1 patient and spondyloepiphyseal dysplasia in 1 patient. Comorbidities were heart problem (bicuspid valve), ear anomaly, cross-eye (oculomotor apraxia), psychiatric problem, tethered cord, diastematomyelia, mental-motor retardation, pes carinatum and deafness. Average initial and last follow-up curve magnitudes were 79.6 degrees (60-105) and 55 degrees (30-65) respectively. The duration of follow-up was 35 months (12-65 months). Instrumented vertebra levels per patients was 13,85 (12-15), surgical procedures per patient was 3,5 (2-6), lengthening procedures per patient was 2,5 (1-5), duration between growing-rod lengthening procedures 6,2 months (6-7,2), unplanned surgical procedures in 3 patients, no patient with final fusion, complications were in 3 patients (42%). Proximal pedicle screw loosening in two patients, implant failure in NF patient changed the treatment to anterior-posterior convex hemiepiphysiodesis. No medical complications reported. Dual growing rod technique was successful in 6 patients (86%).

Conclusions

Growing rods are a safe and effective treatment technique in selected EOS patients with spinal deformities. Dual rods are stronger than single rods and therefore provide better initial correction and maintenance of correction.

OUR EXPERIENCE AND EARLY RESULTS WITH A COMPLEMENTARY IMPLANT FOR THE CORRECTION OF MAJOR THORACIC CURVES

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Aims

We have been using the complementary implant called the CAB hook since 2007 in posterior approach scoliosis surgery.

Materials and methods

The implant simultaneously hooks onto both of the transverse processes. They are available in asymmetric (left and right) and symmetric forms. They exert their correctional force through anatomically identical structures, and after insertion, by alignment of the hooks the spine straightens out in all three planes. They can be used in both the in situ bending and the Cotrel and Dubousset derotation technique. We operated 42 patients with the CAB hook with an average preoperative Cobb angle of 59.3° (28° - 92°). The average follow-up time was 21.6 month (2-51).

Results

All of the patients are satisfied with the results. No reoperation was needed due to loss of correction, pain, implant failure, or infection.

The average postoperative Cobb angle decreased to 24.7° (4°- 60°). Based on this we calculated the Cincinnati Correction Index (CCI) which was 1.53 (0.70-4.8) which means that our correction exceeded the flexibility of the spine based on the lateral bending X-ray by 53%.

Conclusion

As with all new surgical techniques and implants after the short learning curve we were able to improve the degree of correction and decrease the time of surgery. One of the advantages of the CAB hook is that besides a few implant specific instruments, no special instrumentation is required for insertion and image intensifier does not need to be used.

THE "GSCI INDEX" : A NOVEL PARAMETER FOR THE ASSESSMENT OF ADOLESCENT IDIOPATHIC SCOLIOSIS CORRECTION

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Abstract:

With evolving technique and technology, spine surgeons have developed ways to correct the scoliosis deformity. Previously proposed ways of estimating correction level by the "X-Factor Index" and Fulcrum Bending Correction Index does not take into account individual contribution of each vertebra. The Global Spine Correction Index presented here offers a comprehensive procedure suitable for measuring spine correction on both the local vertebral and global whole spine level. This method is also suitable for dealing with both the X-rays only and/or 3-dimensional CT data.

Aims

Previously proposed methods of estimating correction level by the "X-Factor Index" (XFI)[1] and Fulcrum Bending Correction Index (FBCI)[2] do not take into account individual translational and rotational contribution of each vertebra. Thus, the aim of The Global Spine Correction Index (GSCI) presented here, in combination with the previously developed One Number Approach (ONA)[3], was to develop a comprehensive procedure suitable for estimating complex translational and rotational correction as one number that can be easily presented on a simple x, y chart. Also, the aim of the method was to be applicable on the global level of the whole spine and/or localized individual vertebral level.

Materials and methods

Assessment of the curve flexibility pre-op and correction level post-op always employs standard 2-dimensional X-rays and sometimes 3-dimensional CT data. While procedure varies for each data set, underlying methodology for expressing that complex motion stays the same. A representative patient's data sets were collected. They are all initially aligned via sacrum and the pelvic inlet.

In the case of the 2-dimensional X-rays, central vertebral point and line estimating endplate of each vertebra is marked. Vector displacement between center points is noted as the vertebral translation while endplate rotation is estimated by the endplate position. Aggregate sum of individual vertebral migration yields one number that is logged as the global spine correction index.

In the case of the 3-dimensional CT data sets, each vertebra is translated and rotated in space until best fit is achieved. Further, vector displacement is replaced by the total vector value.

Results

In the representative patient data sample, qualitative analysis yields the same trend measuring spine correction. However, maximal error of the X-ray based measurements in both translation and rotational correction is in excess of 10%

Conclusion

The Global Spine Correction Index presented here, in combination with the previously developed One Number Approach, offers a comprehensive procedure suitable for estimating complex translational and rotational correction as one number. As such, this method should be viewed as a valued added parameter for comparing translational and rotational curve correction ability among different series of patients, instrumentation, and surgeons.

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CLINICAL EXPERIENCE IN CELL-BASED THERAPEUTICS: DISC CHONDROCYTE TRANSPLANTATION A TREATMENT FOR DEGENERATED OR DAMAGED INTERVERTEBRAL DISC.

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Abstract:

Disc herniation treated by discectomy results in a significant loss of nucleus material and disc height. Biological restoration through the use of autologous disc chondrocyte transplantation offers a potential to achieve functional integration of disc metabolism and mechanics.

Aims

Chondrocytes that have been removed from damaged cartilaginous tissues maintain a capacity to proliferate, produce and secrete matrix components and respond to physical stimuli such as dynamic loading.

Materials and methods

Nucleus regeneration using autologous cultured disc-derived chondrocytes (ADCT) has been demonstrated in a canine model and in clinical pilot studies. In 2002 a prospective, controlled, randomised, multi-center study, EuroDISC, comparing safety and efficacy of autologous disc chondrocyte transplant, chondrotransplant DISC, plus discectomy (ADCT), with discectomy alone was initiated.

A dog model was used to investigate the hypothesis that autologous disc chondrocytes can be used to repair damaged intervertebral disc.

Disc chondrocytes were harvested and expanded in culture under controlled and defined conditions, returned to the same animals from which they had been sampled (autologous transplantation) via percutaneous delivery. The animals were analyzed at specific times after transplantation by several methods to examine whether disc chondrocytes integrated with the surrounding tissue, produced the appropriate intervertebral disc extracellular matrix, and might provide a formative solution to disc repair.

The clinical goals of the EuroDISC study, were to provide long-term pain relief, maintain disc height and prevent adjacent segment disease. Interim analysis was performed after 2 years; Oswestry (low back pain/disability), Quebec Back-Pain Disability Scale, as well as Prolo and VAS score were used for the evaluation. Disc height was assessed by MRI.

Results

In the context of degenerative changes in an injury model: () autologous disc chondrocytes were expanded in culture and returned to the disc by a minimally invasive procedure after 12 weeks; () disc chondrocytes remained viable after transplantation as shown by bromodeoxyuridine incorporation and maintained a capacity for proliferation after transplantation as depicted by histology; () transplanted disc chondrocytes produced an extracellular matrix that displayed composition similar to normal intervertebral disc tissue. Positive evidence of Proteoglycan content was supported by accepted histochemical staining techniques such as Safranin O-Fast Green; () both Type II and Type I collagens were demonstrated in the regenerated intervertebral disc matrix by immunohistochemistry after chondrocyte transplantation; and () when the disc heights were analyzed for variance according to treatment a statistically significant-correlation between transplanting cells and retention of disc height was achieved.

A clinically significant reduction of low back pain in the ADCT-treated group was shown by all three pain score systems. The median total Oswestry score was 2 in the ADCT-treated group compared with 6 in the control group. Decreases in the disability index and VAS score in ADCT-treated patients correlated strongly with the reduction of low back pain. Decreases in disc height over time were only found in the control group, and of potential significance, intervertebral discs in adjacent segments appeared to retain hydration when compared to those adjacent to levels that had undergone discectomy without cell intervention.

Conclusion

Autologous chondrocyte transplantation is technically feasible and biologically relevant to repairing disc damage and retarding disc degeneration.

***SURGICAL TREATMENT
IN
CERVICAL SPINE TRAUMA
AND
DEGENERATIVE CONDITIONS***

STRATEGY AND TREATMENT OPTIONS IN HIGH CERVICAL TRAUMA

D. Jeszenszky

CERVICOTHORACIC INSTABILITY – A CHALLENGE TO TREAT?

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Aim

Cervicothoracic junction is a complex, potentially unstable anatomic site with unique biomechanical properties. Our aim was to review our surgical cases of cervicothoracic junction pathology.

Methods and results

From 2007 to 2012 we operated 528 patients with pathology in subaxial cervical and thoracic spine. Out of 528 patients, 21 were operated because of pathology at the cervicothoracic junction. Out of those, 13 patients had metastatic infiltration of the vertebral bodies and 8 patients suffered trauma to cervicothoracic junction. No neurological impairment was present in 11 patients prior to the surgery, other had either tetra- or para-paresis/plegia.

In 13 patients we performed posterior cervicothoracic fusion only (in 5 patients with trauma and in 8 with metastases). In 5 patients with metastatic disease we performed posterior cervicothoracic fusion, corpectomy and cage implantation. In one injured patient we performed posterior reduction and stabilisation followed by anterior plating and in 2 other injured patients we performed additional posterior stabilization after anterior graft-plating. 14 out of 21 patients underwent posterior decompression as well.

Conclusion

Trauma of cervicothoracic junction is relatively rare in comparison with tumor infiltrations. Metastatic infiltration is more common than a primary tumor infiltration.

Historically most of the authors recommended both, posterior and anterior surgical approach in case of the instability of the region. Our experience suggests that modern implants and improved surgical techniques allow sufficient stability with the posterior approach only. In case of anterior spinal cord compression a corpectomy and/or discectomy through anterior approach might be considered but it can be technically demanding, especially in the Th1 and lower segments.

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SPINAL CORD INJURY IN PREGNANCY: A CASE REPORT AND LITERATURE REVIEW

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Aims

Spinal cord injuries in pregnancy are extremely rare but when it happens aggressive strategies in acute management and rehabilitation have to be undertaken to ensure optimal maternal and fetal outcomes. Our aim is to review literature and to show a case report of pregnant women with cervical spinal cord injury surgically treated in our institution.

Materials (or Subjects) and Methods

PubMed is searched with key words „spinal cord injury“ and „pregnancy“. Selected articles were classified into basic researches, case reports and reviews. We report the management of a case of acute spinal cord injury in the second trimester of pregnancy.

Results

Most of the existing literature on spinal cord injury in pregnancy is concerned with the management of patients with pre-existing lesions; very few articles deal with acute injuries, but there are some interesting basic researches reporting positive affect of progesteron, stem cell transplantation and beta HCG. In our case we report closed reduction of bifacet dislocation of cervical spine and anterior stabilisation in pregnant women in second trimester. Patient had complete recovery of neurological deficit (ASIA –B at admission) in two days, no acute and late complications and normal delivery of healthy baby.

Conclusions

It is safe to administer corticosteroid therapy according to NASCIS III protocol and to perform surgical decompression and fixation of the cervical spine in pregnancy. Spinal cord injury in pregnancy may have better prognosis of neurological recovery because of neuroprotective effect of progesteron, beta HCG, microchimerism of fetus stem cells. and other still unknown factors.

GUNSHOT WOUND TO THE UPPER THORACIC SPINE ASSOCIATED WITH PERFORATED ESOPHAGUS – CASE REPORT

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Abstract:

Gunshot injuries of the spine are often associated with injuries of other viscera and early diagnosis is mandatory, even though it is very difficult when patient is intubated/unstable. Fiber-endoscopy has been showed superior to radiographic contrast studies and must be considered in this type of injuries.

Aims

To present an unusual case of delayed diagnosis of esophageal perforation after spine gunshot injury that is diagnosed 3 weeks after injury during the anterior approach for anterior decompression.

Material and methods

32 year-old male, victim of gunshot injury of upper chest and spine. Transferred 8 days after injury, Quadriplegic. Radiologic investigations showed fracture of the TH1 with dural compression. CT shows close relationship of NGS in esophagus with the fractured fragment that raises suspicion for esophageal involvement. Patient has also a lung contusion and right side haemothorax. Because of lung injury and of haemorrhagic colitis we have delayed the anterior decompression for 2 weeks. On the 22-th day after injury we have performed anterior surgery where we have found a rupture of the posterior wall of esophagus that has been adhered to the fascia praevertebralis that also has been ruptured accompanied with pyogenic spondylidiscitis. We have done direct suture of the esophagus and feeding gastrostomy.

Results

Esophageal fistula has developed. Posterior decompression was the only way to decompress the spinal cord. Late tracheotomy has been done.

Conclusion

There is a need for individual treatment strategy in pt with gunshot injury of the torso, especially of the neck. Early endoscopic investigation of the gastrointestinal and respiratory tract should be considered even though there is no clinical sign of affection of these systems.

VERTEBRAL ARTERY INJURY DURING REPOSITION AND FIXATION OF FRACTURED C4 VERTEBRA SUCCESSFULLY TREATED WITH ENDOVASCULAR APPROACH

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Background

Vertebral artery injuries due to cervical spine trauma, although rarely described in literature, are relatively common. While most of them will remain asymptomatic, a small percentage of patients may suffer life threatening complications. We report a case of right vertebral artery injury in a patient with fracture of C4 vertebra, successfully treated with endovascular approach.

Case description

A 78-year old male patient was hospitalized for cervical spine injury caused by falling off the tractor. Radiological assessment revealed fracture of C4 vertebra with proximal two thirds of C4 body dislocated five millimeters dorsally. Significant swelling of soft prevertebral tissues distally of C2 segment was also present. During emergency surgery, using standard anterior approach for cervical spine, excessive bleeding started from injured right vertebral artery. Artery was stopped by tamponade with oxidized regenerated cellulose sheet and C4-C5 anterior fixation, after partial reduction of displacement, was done. 15 days later, after angiography, endovascular repair of right vertebral artery was performed, using percutaneous stent graft. Control CT scan angiography showed a valid stent patency, without contrast extravasation.

Conclusion

In cases of cervical spine trauma, surgeon should always be prepared to manage injury of vertebral artery. Bleeding can primarily be stopped by hemostatic packing, and definitive repair can be successfully achieved by endovascular approach, using percutaneous stent graft.

OUR EXPERIENCES IN SURGICAL MANAGEMENT OF CERVICAL SPONDYLOTIC MYELOPATHY WITH LAMINECTOMY

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Aims

Cervical spondylotic myelopathy (CSM) is a common cause of spinal cord impairment.

Materials and methods

In a retrospective study, 55 patients (45 male and 10 female; 29 to 81 years old, median age 60 years) were included. The clinical success was assessed 6 months, 12 months, and then more than 2 years (2 years – 11 years, mean 5.4 years) after the surgery. The outcome was scored by modified Macnab criteria; Nurick myelopathy scale score and Japanese Orthopedic Association Score (JOA).

Results

In our group, all patients were treated with laminectomy. Mean Nurick myelopathy scale score before the operation was 3.4 (range 1 - 5) and mean JOA score before the operation was 10.4 (range 4 – 15). Six months after surgery, the excellent/good outcome according to Macnab criteria was noted in 21 (41.2 %) of our patients, mean Nurick myelopathy scale score was 2.4 and mean JOA was 13.4. No follow-up data were available for 4 patients. One year after surgery 20 (51.3 %) patients reported an excellent/good outcome, and 1 patient (2.6 %) had a poor outcome. Mean Nurick myelopathy scale score after one year was 2.3 and mean JOA after one year was 13.4. The mean long term follow-up period for 29 patients was 5.4 years (SD = 3.1; range 2-11). The 2 to 11 year outcome data showed clinical improvement (excellent/good results according to Macnab criteria) in 12 (41.4%) out of 29 of patients. Mean Nurick myelopathy scale score was 2,1 in the long term follow up group and mean JOA in this group was 12,9.

Conclusions

The results of this study suggest that patients with CSM undergoing laminectomy may have favourable clinical outcomes with regard to neurological status and postoperative complications.

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A TETRAPLEGIA SYNDROME OCCURRING AFTER ADEQUATE ANTERIOR AND POSTERIOR DECOMPRESSION FOR CERVICAL SPONDYLOARTHROSIS: BIOMECHANICS OF INJURY CASE REPORT

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Aims

Case report with review of the literature. To present the first case of a tetraplegia syndrome in our department occurring after adequate anterior and posterior decompression, and review the mechanics of the cervical spinal cord injury and postoperative biomechanical and anatomic changes occurring after cervical decompressive laminectomy.

Materials and methods

Cervical spondyloarthrosis is a common pathoanatomic occurrence in the elderly population and is thought to be one of the primary causes for a cervical myelopathy. Anterior decompression and laminectomy with or without fusion has been a primary treatment for spondylotic disease and is thought to be protective against further injury. Case study with extensive review of the literature.

Results

The patient underwent at first anterior decompression C3-C4/C4-C5/C5-C6 with improvement of spasticity and gait difficulties. At second stage were achieved C3-C7 laminectomy and lateral mass instrumentation. After cervical laminectomy were established a tetraplegia syndrome with lack of deep sensibility. The patient was treated conservatively for the tetraplegia syndrome and had minimal improvement.

Conclusions

Decompressive laminectomy provides an immediate decompressive effect on the spinal cord as seen by the dorsal migration of the cord, however, the biomechanics of the cervical spine after decompressive laminectomy remain uncertain. This case supports the ongoing research and need for more intensive research on postoperative cervical spine biomechanics, including decompressive laminectomies, decompressive laminectomy and fusion, and laminoplasty.

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PRIMARY SURGICAL TREATMENT OF SYMPTOMATIC ANTERIOR CERVICAL OSTEOPHYTES: PLAIN RESECTION OR INSTRUMENTED FUSION?

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Aims

To present the long-term results of a retrospective case series of 10 patients who were surgically treated for symptomatic anterior cervical osteophytes, along with the results of a systematic latest related literature search. We aim to show which of the possible published surgical techniques is optimal for the surgical treatment of this rare pathology.

Patients and methods

Records of 10 patients (9 male, 1 female) treated for symptomatic cervical osteophytes between 2000 and 2008 were revised. All complained of either dysphagia or dyspnea or both. Every patient had undergone plain radiography, contrast esophagography, CT and/or MRI imaging. Treatment consisted of left lateral cervicotomy and osteophylectomy at the levels, where imaging showed soft tissue compromise or where osteophytes were larger than 10 mm. Sizes of osteophytes and functional outcome swallowing scale (FOSS) were measured before surgery and at final follow up. We performed a systematic review of literature from 2006.

Results

Average age at surgery was 69,5 (63-77) years, average follow up 61,9 (15-117) months. 25 osteophytes were resected, their average size was 12,7 mm (4-22) preoperatively and 5,12 mm (0-12) at final follow up. Average functional outcome swallowing scale (FOSS) score before surgery was 3,3 (2-5), 1,2 (0-5) at final follow up. Only one patient had re-occurrence of symptoms due to osseous aetiology.

Conclusion

Ventral cervical osteophytes causing dysphagia with or without dyspnea can be successfully treated by surgery. In majority of patients osteophytes do not re-grow significantly in long term, precluding the need of prophylactic instrumented fusion after osteophyte resection.

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***BASIC SCIENCE
IN
DEGENERATIVE SPINE DISORDERS***

NUTRITION OF THE INTERVERTEBRAL DISC

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The disc is the largest avascular tissue in the body with cells in the centre of an adult lumbar disc 6-8 mm from the nearest blood supply. In order to function and remain viable, the cells which make and maintain the disc tissue, require an adequate nutrient supply, and also an efficient means of removing products of metabolism such as lactic acid. Nutrients reach the cells of the nucleus pulposus, the central area of the disc, by diffusing from blood vessels of the vertebral body through the cartilage endplate into the disc matrix under concentration gradients set up by cellular metabolism.

Even in a normal healthy disc, oxygen and glucose levels in the centre of the nucleus are low as the cells consume these nutrients and set up gradients which depend on disc size, and cell activity. Lactic acid is produced by disc cells at high rates and accumulates, leading to a fall in tissue pH. Failure of nutrient transport and the consequent further fall in pO₂ and glucose concentrations and increase in lactate level could affect cellular activity and even cell survival adversely and may thus be one route to disc degeneration.

Here we will discuss some factors affecting nutrient transport to the disc such as the path from the blood vessels into the disc, the effect of load-induced fluid loss and of degeneration on solute diffusivity of the matrix, disc cell density in relation to disc size and factors affecting the rates of cellular metabolism. We will review recent work on electrode tracer measurements and on serial post-contrast MRI studies which allow investigation of nutrient pathways in vivo and have demonstrated a direct relationship between degree of disc degeneration and failure of nutrient supply.

ANGIOGENESIS AND NEUROGENESIS IN DISC DEGENERATION

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Abstract:

The healthy adult intervertebral disc has few blood vessels and innervation is normally restricted to its outer layers, but when discs become degenerate or herniated, the tissue is invaded by an increase in both nerves and blood vessels[1,2]. There appears to be several reasons why angiogenesis and neurogenesis are normally inhibited in the disc, and why their inhibition is overcome in degeneration. Glycosaminoglycan or GAGs (the sugar chains attached to proteoglycans) within the disc almost certainly play a role via two mechanisms. Firstly, GAGs are known to inhibit nerve growth and endothelial adhesion[3,4], such that their high levels, particular in the centre of the healthy disc can inhibit nerve and blood vessel growth. When GAG levels are reduced in degenerate discs, this inhibitory effect is likely to be lessened. Secondly, GAGs are responsible for creating a high osmotic pressure within the disc, which is likely to restrict formation of a lumen such as, is necessary in blood vessel development, at least in healthy discs where a high pressure occurs. There are also other cytokines and growth factors which can have positive angiogenic and neurogenic effects, including VEGF or BDNF, respectively. These factors are known to be present in degenerate intervertebral discs. It is important to try to elucidate the exact sequence(s) of events, which may differ between individual intervertebral disc pathologies, to develop ways of stopping these detrimental events as appropriate.

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BRIDGING RESEARCH OF IVD DEGENERATION WITH CLINICAL NEED FOR REGENERATIVE TREATMENT - ASPECTS FOR CELL THERAPY APPROACHES

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Aims

New therapies including biological repair are being investigated within a European-funded research project, GENODISC, mainly focussed on gaining knowledge of factors involved in the development and progression of intervertebral disc degeneration and improving diagnoses.

Several approaches to biological therapy for treating disc degeneration have been developed. Growth factor therapy is being investigated mostly in terms of its effects on cell proliferation and cell senescence and appears effective in animal studies. Likewise many laboratory and preclinical studies of cell therapy have been undertaken and it is being used in a few centres around the world.

Various cell sources have been proposed for cell therapy, such as chondrocytes from different cartilages and mesenchymal stem cells. For any therapy to be effective the environment must permit the cells to stay alive and active. Hence the cells need to function in the specific environment of the disc with its low pH, glucose and oxygen and high osmolarity.

Materials and methods

For biological therapies to be effective, several issues have to be defined, especially the clear definition of a patient group that could benefit from any specific therapy. GENODISC is investigating diagnostic means for selecting patients who might benefit from such therapies.

We are testing sensitivity of potential cell sources to extreme physiologic conditions, especially their sensitivity to high osmolarity. Adipose derived stem cells (ASCs) were evaluated for the purpose of degenerated disc treatment. Cells from 4 primary cultures were exposed to different osmolarities (300, 400, 500, 600 and 900 mOsm) in monolayer culture and in form of pellet cultures. Cell viability and chondrogenic differentiation were evaluated after 4 weeks of exposure.

Results

An algorithm for definition of specific patient groups and potential biologic therapies has been developed within consortium.

Viability of ASCs in medium with disc-like osmolarity (400, 500 mOsm) was comparable to results of control group (300 mOsm). Proliferation rate slightly decreased under this

conditions. But significantly higher osmotic conditions (600, 900 mOsm) negatively affected the viability and proliferation of ASCs. We also noticed that the actin structure was destructed and there were some changes in DNA organisation.

Conclusions

The aim of cell therapy will differ depending on the defined patient groups and can include prevention of : (1) further degeneration of the disc, (2) disc space collapse following herniation, (3) recurrence of disc herniation, (4) adjacent disc degeneration and (5) promotion of spinal fusion.

Adipose derived stem cells, as potential cell source for cell therapy of intervertebral disc appear to be resistant (in terms of cell viability) to high osmolaritic conditions, as they appear in degenerated intervertebral disc, however their regenerative capacity needs to be compared to other potential cell sources.

ISOLATION OF HUMAN NUCLEUS PULPOSUS AND ANNULUS FIBROSUS CELLS

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Aims

To study possible mechanisms of intervertebral disc (IVD) degeneration, *in vitro* organ culture systems with live disc cells are highly appealing. Most disc cells are isolated from animal tissue. We established a relatively quick and easy protocol for isolation of nucleus pulposus (NP) and annulus fibrosus (AF) cells out of the IVD fragments with a high yield and low risk for contamination.

Materials and methods

Human intervertebral disc fragments can be obtained following discectomies. In sterile conditions, disc fragments are collected. The tissue is cut, grinded and partially digested with trypsin. After sequential centrifugation and separation, sediment is harvested and cells seeded in suspension, supplemented with special media containing high nutrient level. Characterization was made and sub-isolation of nucleus NP and AF cells followed.

Results

In appropriate environment, isolated cells retained viability and proliferated quickly. Attachment was observed after 6 hours and proliferation after 12 hours. Time to confluence was 96 hours. Cell proliferation, apoptosis and cell senescence were examined after 16 days in culture. Both NP and AF cell cultures were stable. Under standard culture conditions, cell proliferation and cluster formation was observed. Cell viability was 90%. The number of apoptotic cells and enucleated cells was positively correlated to cell seeding density.

Conclusion

The demonstrated isolation process is simple, quick and economical, allowing viable long-term organ culture. The availability of such system will permit to study cell properties, biochemical aspects and the potential of therapeutic candidates for human discs in a well-controlled environment. Due to its advantages, the isolation technique demonstrated here can be extended to other animal species such as porcine, ovine and leporine caudal and lumbar disc isolation. Thus, this study has implications for both our understanding of degenerative disc disease and also cell-based therapy using isolated cells.

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ULTRASTRUCTURE OF LUMBAR VERTEBRAE BIOMINERAL WHEN HYDROXYLAPATITE MATERIAL SATURATED WITH ZINC IS IMPLANTED IN THE TIBIA

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Abstract:

It's currently under active development the materials for their use as bone implants. Great opportunities for learning materials are based on hydroxyapatite. In this paper, we examine the impact of such material, provided saturation with zinc.

Aims

Our purpose is to study the ultrastructural features of the white rats third lumbar vertebra under condition when hydroxyapatite material OK-015, saturated with zinc is implanted in the tibia.

Materials and methods

Studies have been conducted on 252 white male rats with an initial body weight 135-145 g, divided into several groups: intact animals, the rats with artificial bone defect in the tibia, with defect filled by hydroxyapatite blocks (material OK-015), next groups - defect was filled by blocks of OK-015, saturated with zinc at concentrations of 0.20%, 0.50% and 1.00%.

Results

Application of defect in the tibia was accompanied by a destabilization of the crystal lattice of the lumbar vertebral bone mineral, which may be a manifestation of the "syndrome of fracture." When material OK-015 was implanted in the tibia in the period from 7 to 30 day, the signs of destabilization increases. Saturation of OK-015 by zinc was accompanied by an even greater manifestation of destabilization in the biomineral (decline of the microtexture coefficient) to 7 and 15 day. On day 30 the size of the cellulae of the vertebra in 5-6th groups was less than in the third group, and crystallite size and the microtexture coefficient the same as in group 1 to the 90 and 180 days. This can be seen as a full restoration of the ultrastructure of vertebra biomineral after implantation in the tibia OK-015, saturated with zinc.

Conclusion

Our results show that the saturation of the implant material OK-015 with zinc has positive effect on the progress in the repair of bone.

ASSOCIATION BETWEEN CHD7 AND IL-6 GENE POLYMORPHISMS AND IDIOPATHIC SCOLIOSIS IN BULGARIANS: A PILOT STUDY

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Abstract:

The promoter polymorphism -174 G/C in IL-6 and the CHD7 gene polymorphism rs4738824 have been reported to be associated with the etiology of idiopathic scoliosis (IS) in Caucasians.

Aims

We conducted a pilot case-control study aimed to investigate the *association* between *CHD7* and *IL-6* gene polymorphisms and IS in Bulgarian patients.

Materials and methods

DNA probes extracted from peripheral blood of 30 patients with IS and 73 unrelated healthy controls were analyzed by restriction fragment length polymorphism analysis (RFLP) and Fast Real-Time TaqMan PCR.

Results

This pilot study revealed association between IL-6 and CHD7 gene polymorphisms and the genetic predisposition to IS. Our results show that the G/G genotype of IL-6 gene polymorphism (-174 G/C) and the G/G genotype of CHD7 gene polymorphism rs4738824 are associated with increased OR (OR 1.67 and OR 1.63, respectively).

Conclusion

A much larger population-based case control study will be needed to confirm these results. Our findings suggest that the identification of molecular markers with prognostic and diagnostic value could be a useful means for the early detection of children at risk for the development of IS.

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CLINICAL SUBGROUPS OF LOW BACK PAIN PATIENTS ARE SIGNIFICANTLY RELATED TO SURGICAL OUTCOME

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Aims

Surgery for back pain has been shown to yield poor results in 15-45% of patients. The objective of the study was to identify significant subgroups in low back pain patients indicated for single level fusion and to determine the associations among the clinical clusters and the outcome of the surgeries.

Materials and methods

Patients (N=114) completed a questionnaire booklet containing the Oswestry Disability Index, VAS on low back and leg pain, Zung Depression Scale and the Modified Somatic Perception Questionnaire before the surgery and one year after the single level fusion surgery. Two-step agglomerative cluster analysis was used to determine the best fit cluster. Chi-square tests were applied to investigate the clinical outcome in the different subgroups.

Results

Three subgroups (clusters C1-3) were based on the preoperative clinical features. Disability, depression, somatization and pain were a significantly different among the subgroups ($p < 0.001$). Relatively worst outcome was found in the C1 cluster, where 18% of the patients reported "definitely worse" spinal condition at 1 year follow-up (5% in C2 and 0% in C3, $p = 0.004$). 29% of the patients in C1 cluster reported that the surgery did not helped them (9% and 6% in C2 and C3, $p = 0.004$).

Conclusion

Low back pain patients are divided into subgroups (clusters) based on the clinical features. Our results showed that the clinical outcome after single level fusion surgeries was significantly different in these clusters. In the clinical subgroup characterized by high level of pain, disability and psychological factors, the risk for bad outcome was much higher than in the other two clinical subgroups.

**SURGICAL TREATMENT
OF
ELDERLY SPINE
AND
SPINE INFECTIONS**

SURGICAL TREATMENT OF ELDERLY SPINE: STATE OF THE ART

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Spinal disorders in elderly and usually frail patients with polymorbidity have become a major challenge in spinal surgery. It is not only a major challenge in terms of technical and surgical demands, but also a major challenge in terms of increasing numbers of these patients and the consequences for the treatment. The medical infrastructures are heavily loaded by these pathologies and an interdisciplinary approach to these patients is unavoidable. More and more the surgeon plays here the role of a highly specialised consultant for the specific spinal problem, which needs to be treated in the context of the whole medical care. Therefore, complex spinal problems in elderly patients belong in major medical centres to make sure that these cases can be handled together in an interdisciplinary team. More than ever before, we have to understand the concept of spinal balance, since catastrophic results may occur, if we are not able to give a proper sagittal balance of the spine. Elderly patients do not have anymore the potential of spontaneous compensation mechanism, in order to regulate their posture when upright.

Less invasive technology needs further developed for the elderly, frail patient, since they may not anymore tolerate major invasive surgery and yet their demands for quality of life are increasingly high.

OUR EXPERIENCE WITH THE USE OF BONE CEMENT IN DEGENERATIVE SPINE SURGERY

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Aim

The use of bone cement in orthopaedic surgery has been quite current for many years. In spine surgery it has been used first for replacing defects after corpectomy. Then vertebroplasty and kyphoplasty got used world-wide. Sporadically some surgeons used cement to refill the intervertebral space after discectomy, combined with dorsal stabilization and fusion. Most recently in our institution we started to perform routinely Percutaneous Cement Discoplasty, for elderly patients. In selected cases we also used bone cement as a custom made spacer, allowing to perform interbody fusion also.

The aim of this study was to review retrospectively this group of patients, as the authors hypothesis is that a PMMA custom made spacer has advantages on preformed interbody cages.

Material and methods

We reviewed our last 50 patients who underwent lumbar TLIF with the use of PMMA as spacer. We evaluated the clinical results with standard questioners. Radiological evaluation focused on bony fusion, loosening of any instrument implanted (PMMA spacer or screws), osteolysis around the cement, subsidence, changes in segmental, and overall lordosis according to the position of the cement spacer.

Results

After an average of 1 year follow up the clinical results are very good or good in 38 patients (76%). In 80% of the cases bony fusion can be seen on CT scan after 6 months. Only one case was detected where subsidence occurred (0,5%) and in one other case we observed osteolysis around the spacer. The average correction of segmental lordosis was 6° and with a posterior position of the spacer less correction could be obtained compared to anterior position.

Conclusion

A custom made PMMA spacer can be used for TLIF in younger population with good results and it even has some advantages on preformed cages.

REOPERATIONS OF THE PATIENTS WITH THE LUMBAR SPINE STENOSIS IN GENERAL HOSPITAL JESENICE

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Aims

Stenosis of the spinal canal is the main problem of the older patients operated on spine. We present the reoperated cases.

Subjects and Methods

From 01.01.2007 to 31.12.2011 we operated 192 patients the lumbar spine stenosis. 58 had radiological stenosis with localized clinical problems so only hemilaminectomy (1 lamina, 1 side) with or without herniectomy was done- Hemilaminectomy group. 134 patients had radiological and clinical stenosis so laminectomy (both laminae, 1 or more levels) was done- Laminectomy group. Reoperation rate in both and final outcome in the Laminectomy group were controlled.

Results

In the Hemilaminectomy group 17 reoperations (29,3%) were made. 6 women, 9 men, 39 to 74 years range, average 57,3. 1 reoperation was urgent because of cauda syndrome and 2 early for recidivant hernia. 14 reoperations were done later (0,5 to 14 years interval, average 2,96). 2 had recidivant hernia, 1 adjacent, 3 hernia recidive with laminectomy, 4 laminectomies and 4 scar release.

In the Laminectomy group 18 (13,4%) reoperations were made. 11 women, 7 men, 44 to 85 years interval, average 61,3. 6 were urgent: 2 cauda syndrome, 2 neurological deterioration, 2 liquorea. 13 were reoperated later (range 1 to 10 years, average 3,0). 9 additional laminectomies, 2 new hernias and additional laminectomies, 2 new hernias. One patient was reoperated urgently (liquorea) and later (new hernia).

Final results of urgently reoperated: 1 was sent to pain clinic, 1 to another hospital (not reoperated), 1 retired, 2 had mild problems and only 1 was ok. Of 13 reoperated later 2 were stabilized in another hospital (1 also retired), 2 retired, 3 had mild problems, 6 were good.

Conclusions

In our hands wider release of the spinal canal meant better results ($p=0,001$). The time of the reoperation did not influence the final results.

SPINAL INFECTIONS – DIAGNOSIS AND TREATMENT

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Spinal infections can occur in variety of clinical situations. Their presentation can range from acute to chronic phase. Early detection obviates the need for surgical treatment. When surgical treatment is indicated, in almost all cases anterior surgery is performed.

The aim of this study is to present our experience in diagnosis and surgical treatment of the spinal infections.

Material and methods:

From 1995 to 2010, 55 patients (pt) with spinal infection were surgically treated. Tuberculous (TB) osteomyelitis was present in 29 pt; pyogenic in 8 pt; postoperative spinal infection in 16 pt; brucellosis in one and echinococcosis in 1 pt. Spinal pain associated with paraspinous muscle spasm, fever, elevated ESR, CRP were present in patients with pyogenic osteomyelitis, night sweating, malaise, weight loss, kyphotic deformity, elevated ESR were present in TB osteomyelitis. Neurologic deficit was present in 32%. Diagnostic protocol included: history, physical examination, CT, MRI, biopsy (if needed). Medical treatment was started with course of parenteral antibiotics during 2-6 weeks, followed with peroral antibiotic therapy. Three-four tuberculostatics were administered in patients with tuberculous osteomyelitis during 6 months. Indications for surgical treatment (debridement of granulations, necrotic tissue and structural destruction, application of tricortical iliac crest graft/mesh/cage and stabilization) was intractable pain, instability, deformity, neurological deficit. Anterior surgery was performed in 32 pt, drainage and debridement in 10 pt, costotransversectomy in 4 pt, combined approach in 3 pt, and posterior approach in 6 pt.

Results

In 92% of all treated patients with spinal infection clinical and neurological improvement and solid fusion was achieved. In the rest 8% additional surgical procedures were undertaken (removal of the implants, additional drainage, debridement of the wound or fixation).

Conclusion

Successful diagnosis (early detection of pathogenic organisms) and medical treatment is crucial because may obviate the need for surgical intervention. When surgical debridement is indicated, anterior spine surgery should be undertaken. Results of this study support the other studies that anterior spine surgery, brings great benefit to clinical and neurosurgical improvement in patient with spinal infection.

SPONDYLODISCITIS, DIAGNOSTIC AND TREATMENT DUBIOSIS

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Last few years we have the progression of spine infections-spondylodiscitis. One group of this infections which depend on same kind of surgery procedures are not are serious problem. The other group with nonspecific symptoms, slow progression are diagnostic problem and we lost of time(months) to made a correct diagnosis. But, after that we have a doubt how to treat this patients. Do we start with nonspecyfic antibiotics, or with antituberculotics drugs? Is it necessary to do erly suregery, or waiting and do it later?

ANTEROPOSTERIOR INSTRUMENTATION WITH SINGLE POSTERIOR APPROACH FOR TREATMENT OF PYOGENIC OSTEOMYELITIS OF THORACIC AND LUMBAR SPINE

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Aims

Surgical treatment of thoracolumbar osteomyelitis consists of radical debridement, reconstruction of anterior column either with or without posterior stabilization. The objective of present study is to evaluate a case series of patients with osteomyelitis of thoracic and lumbar spine treated by single, posterior approach with anterior and posterior column instrumentation.

Materials and methods

17 patients underwent clinical and radiological evaluation pre and postoperatively with latest follow-up at 19 months (8-56 months) after surgery. Parameters assessed were site of infection, causative organism, angle of deformity, blood loss, duration of surgery, ICU stay, deformity correction, time to solid bony fusion, ambulatory status, neurologic status (ASIA impairment scale), and functional outcome (Kirkaldy-Willis criteria).

Results

Mean operating time was 207 minutes and average blood loss 1150 ml. Patients spent 2,3 (1-4) days in ICU and were able to walk unaided 1,6 (1-2) days after surgery. Infection receded in all 17 patients postoperatively. Solid bony fusion occurred in 15 out of 17 patients (88%) on average 6, 3 months after surgery. Functional outcome was assessed as excellent or good in 82% of cases. Average deformity correction was 8 (1-18) degrees, with loss of correction of 4 (0-19) degrees at final follow-up.

Conclusion

Single, posterior approach addressing both columns poses safe alternative in treatment of pyogenic vertebral osteomyelitis of thoracic and lumbar spine. Compared to other approaches it proved to be less invasive with faster postoperative recovery.

OPERATIVE TREATMENT OF SPINAL TUBERCULOSIS

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Introduction

Spinal tuberculosis most commonly involves the thoracic spine. Infection begins in the anteroinferior aspect of the vertebral body with destruction of the intervertebral disc and adjacent vertebrae. **Kyphosis and neurological impairment are the major residual problems of spinal tuberculosis after the microorganism has been eradicated with use of appropriate medications.** The resulting anterior wedging and angulation of adjacent vertebral bodies with disc space obliteration are responsible for the palpable spinal prominence (gibbus) and a classic radiographic appearance. **Spinal instrumentation is needed to support anterior strut grafts in patients who have kyphosis that affects more than two levels.** Paraspinal and psoas abscesses can develop with extensions to the adjacent tissues.

Methods

Several approaches have been used in the management of thoracic spine tuberculosis to achieve the goals of decompression of the cord followed by stabilization and antituberculous therapy. The authors report their experience with a transpedicular and intercorporeal fixation with decompression followed by external immobilization and prolonged antituberculous therapy.

Summary of background data

The data of 6 patients were reviewed retrospectively for clinical outcome, and kyphotic angle was measured on the follow-up radiographs to ascertain progression of kyphosis.

Results

There was no worsening of the neurologic status in any patient. All patients were returned to functional activity. There was no significant progression of kyphosis.

Conclusions

Our results show that the transpedicular approach with intercorporeal grafting is a safe surgical procedure for ventral decompression in thoracic spine tuberculosis, followed by chemotherapy for 12 to 18 months.

LUMBOISCHIALGIC PAIN AS A RESULT OF CAUDA EQUINA ABSCESS: A REPORT OF A CASE

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Aims

Lumboischialgic pain is often encountered in everyday clinical practice. It may be caused by various factors. Infrequently, spinal abscess may be the reason for sciatic pain and may demonstrate similar symptoms. Spinal intradural abscess is an uncommon clinical entity with poor prognosis, unless treated immediately and aggressively.

Materials and methods

A 32-year old gentleman was admitted to the emergency department due to lumboischialgic pain. It was radiating down the anterior and lateral aspect of the left leg to the foot and was progressing in the intensity in the weeks before the admission. He complained of lowered muscle strength in the left foot. Neither sensory complaints nor bowel and bladder disorders were reported by the patient. No elevated body temperature was experienced.

Results

Neurological examination found only decreased strength and limited range of dorsal flexion of the left foot and toe. The Lassegue test was negative. The sphincter function was good. On MRI imaging, an intradural tumorous formation of 2cm in diameter was seen in the region of cauda equina at the level of L2, slightly on the left side of the spinal cord, compressing the neural structures. No disc pathology was found. Operation was indicated. During the dissection, pus was drained from the formation. It was evident after image diagnostics and surgery, that an intradural abscess of cauda equina was the cause. Postoperatively, the patient received empirical antibiotic treatment with vancomycin and cefotaxime. Muscle strength gradually improved. The recovery was uneventful.

Conclusion

Because intradural abscess is an infrequent and dangerous form of pathology, a high level of suspicion must be present when treating a patient with back pain, neurologic symptoms and signs of infection. Immediate spinal decompression and evacuation of the abscess in conjunction with appropriate antimicrobial therapy is required, particularly in cases with neurologic deficits.

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ROLE OF THE FDG PET/CT SCAN IN A DIAGNOSTIC – THERAPEUTIC ALGORITHM FOR SPINE INFECTIONS

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Abstract:

Spine infections require a multidisciplinary approach to be treated and solved. A guide line to drive physicians in the deep complexity of such a disease is extremely helpful. Authors suggest a flow chart built up on clear concepts such as right and well managed antibiotic therapy, sound stability of the spine, correct and smart use of the standard and functional imaging techniques, such as F18 FDG PET/CT.

Aims

The aim of the study is to assess the role of PET/CT for the early evaluation of spondylodiscitis treatment, in comparison to C-reactive Protein serum levels.

Materials and methods

Enrolled in the study were 34 patients diagnosed with hematogenous spine infections. All the patients included underwent a FDG PET/CT and determination of CRP level at baseline and again 2-4 weeks after therapy start. PET results (SUV of the 1st and 2nd scan and DeltaSUVmax) were compared to the inflammatory indexes and clinical status during therapy.

Results

The mean SUVmax at diagnosis was 8.6 ± 3.7 . The mean CRP level at diagnosis was 3.8 ± 3.8 mg/dl. A progressive clinical response was seen in 26 patients. In responders, SUV-2 and CRP-2 were significantly lower than SUV-1 and CRP-1 ($p < 0.0001$ and $p = 0.001$, respectively). ROC curves about sensitivity and specificity of every single parameter have been described.

Conclusion

Delta SUV max provided a higher sensitivity and specificity for identifying responders. SUV-2 provided comparable sensitivity, but significantly lower specificity. CRP level performed worse for identifying responders. No significant difference in the global performance of the two tests, however higher sensitivity of the Delta SUV max for the early identification of responders may have an important clinical impact in guiding antibiotic therapy especially in patients with a noninformative CRP test at diagnosis.

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***SURGICAL TREATMENT
OF
SPINE TUMORS***

SURGICAL TREATMENT OF HIGH CERVICAL TUMORS

D. Jeszenszky

SURGERY OF THE PRIMARY SACRAL TUMORS

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Sacral tumors are rare pathologies, but their management generally generates a complex medical problem. They usually are diagnosed in advanced stages with extended dimensions involving the sacral nerves and surrounding organs. The evaluation and complex treatment of these rare tumors require a multidisciplinary approach, optimally at institutions with comprehensive care and experience. Surgical treatment of sacral neoplasms is one of the most challenging fields of spine surgery because of the complicated anatomy of the sacral site. In most cases, only radical surgical procedures can guarantee optimal local control. En bloc resection with wide surgical margins is essential for long-term local oncologic control, although often it is technically quite difficult to achieve because of anatomic relationships and large tumor size. Beyond the primary goal of the surgery, the optimal spino-pelvic reconstruction focused on biomechanical stability and soft-tissue restoration is also indispensable. The success of the complex treatment depends on the strict follow-up and the patient's cooperation. Just a few centers in the world have enough wide experience and perform a large number of sacral tumor surgeries. Therefore, an international cooperation and registry should be organized through which centers with a special interest in these cases could work together according to mutually established protocols.

SURGICAL TREATMENT OF PRIMARY AND METASTATIC SPINAL TUMORS

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The anterior column of the spine is the most common site for skeletal metastases and rare localization of primary tumors. Anterior spine surgery (ASS) is usually indicated in the treatment.

The aim of this study is to present our experience in diagnosis and surgical treatment of the spinal tumors.

Material and methods:

From 1995 to 2010, 96 patients (pt) with spinal tumors were surgically treated. Metastatic tumors were present in 85 pt, primary spinal tumors in 11 pt. There were 56 male pt and 40 female. Thoracic spine was involved in 68%, lumbosacral in 20% and cervical in 12%. Diagnostic protocol included: history, physical examination, x-ray, CT, MRI, bone scan, biopsy (if needed). Neurological deficit was present in 85 pt. Neurological status was graded according Modified Frankel Grading System (A1 – 3; A2 – 5; B – 14; C – 24; D1 – 26; D2 – 13; E - 11). Progressive axial pain, spinal fracture, deformity, instability and neurological compromise with motor dysfunction, myelopathy or radiculopathy were most common indications for surgery. Extent of lesion and surgery were determined by Harrington and Tomita scoring system. Probability of survival was evaluated by Tokuhashi Revised Scoring System. ASS only was performed in 84 pt and combined approach in 12 pt. ASS included: corpectomy and wide excision of tumor mass, application of titanium mesh or extendible body and anterior stabilization.

Results

Clinical improvement was seen in 80% of the patients. Neurological improvement of at least 2 grades was found in patients with preoperative grade A1-C.

The mean postoperative survival period for patients with breast carcinoma, lymphoma was 28 months and 11 months in lung cancer. The rapidity of onset of muscle weakness had the worst prognosis for recovery. Primary spinal tumors had better prognosis than metastatic tumors.

Conclusion

Based on these results we believe that patients with anterior spinal pathology, especially those with progressive neurologic compromise caused by cord or roots compression from vertebral collapse or instability should be treated with ASS (decompression, reconstruction and stabilization). The ASS brings benefit to clinical and neurological improvement and quality of life of the patients.

BALLOON KYPHOPLASTY IN NEOPLASTIC LESIONS OF THE SPINE

E. Sucher

PRIMARY MALIGNANT SPINAL CORD TUMORS - IMPACT OF EXTENT OF SURGICAL RESECTION ON OVERALL SURVIVAL

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Aims

Primary malignant spinal cord tumors represent a minor subgroup of spinal cord tumor pathology with a poor prognosis. Various factors such as patient age, neurological status before surgery, tumor type and grade, extent of surgical resection and adjuvant therapy are reported to influence patient outcome. Our aim was to establish the role of extent of surgical resection as an independent parameter of outcome in these patients

Materials and methods

We performed a retrospective analysis of data from patients with primary intramedullary spinal cord tumors operated on at our institution between January 2006 and January 2012. We analyzed the influence of surgical radicality evidenced intraoperatively and on short-term neuroradiological follow-up on patient outcome.

Results

During the analyzed period 32 patients with primary intramedullary spinal cord tumors were operated on at our institution. Of these 7 (21,9%) were patients with malignant tumors. Histological analysis revealed 4 glioblastoma multiforme (GBM), 2 anaplastic ependymomas (AE) and 1 primary spinal primitive neuroectodermal tumor (PNET). There were 4 male and 3 female patients. Mean age was 33 years (range, 7-65 years). Gross total resection was achieved in 5 patients and partial resection in 2 patients. Mean overall survival time was 24 months (60 months for PNET, 26,5 months and for AE and 15 months for GBM). Two patients had intracranial dissemination of disease, associated with decreased survival.

Conclusion

We found that poor clinical outcome in patients with primary malignant intramedullary spinal cord tumors in our series is correlated only with tumor type and grade, and is not influenced by other factors, such as the extent of surgical resection.

SURGICAL TECHNIQUE FOR PANCOAST TUMOR RADICAL RESECTION

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USE OF THE O-ARM SYSTEM IN OPERATIVE CORRECTION OF CRANIOCERVICAL, ATLANTOAXIAL AND HIGH CERVICAL INSTABILITY IN PATIENTS WITH BENIGN AND MALIGNANT LESIONS

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Introduction

A retrospective and prospective analysis of the surgical treatment and results of 36 patients with benign and malignant craniocervical, atlantoaxial and high cervical lesions operated during 18 – month period (2011-2012) at the Department of Neurosurgery, Klinikum Fulda gAG, was performed.

Aim

The aim of the analysis was to assess the factors affecting dorsal fusion as correction of craniocervical and high cervical instability.

Material and methods:

The mean age of the patients was 54 years. The female to male ratio was 1:1,4. The most frequent neurological symptoms were quadriparesis, discoordination, cranial and spinal nerves palsy and local pain. We analyzed 17 patients with traumatic lesions, 5 patients with inflammatory lesions, 8 patients with degenerative instability, and 6 patients with high cervical tumors. In the subgroup of patients with traumatic lesions we found 12 odontoid fracture Type II, 1 Hageman fracture and 4 combined cervical fracture; in the subgroup of patients with tumors we observed 1 case with plasmocytoma, 1 case with chordoma, 1 case with C3 schwannoma, and 3 cases with metastatic lesions; in the inflammatory subgroup we analyzed 5 cases with RA and ankylose spondylitis.

Findings:

In 36 patients we performed 40 operations. We used posterior cervical, and craniocervical median approach. Because of craniocervical/cervical instability we made posterior screw fixation in all of 36 patients. In 14 patients we performed additionally decompressive laminectomy. In order to improve screw placement accuracy we performed intraoperative O-Arm in 28 cases. The most common operative complications were: CSF leak – in 1 case, postoperative infection – in 2 cases, without early operative mortality. The 6-months follow-up showed good recovery in 27 patients, moderate disabling – 5 patients, severe disabling – 1 patient, vegetative state – 1 patient, death – 2 patients with malignant lesions.

Conclusions

Early correction of craniocervical and high cervical instability facilitated neurological recovery by preserving the existent neurological function. Using of O-Arm increase operative screw placement accuracy, and preserve intraoperative nerve and vertebral artery injury.

Recently because of the improvement of neuroimaging techniques, operative approaches, surgical techniques and neurointensive care the results of treatment of these lesions are sufficiently improved.

LANGERHANS' CELL HISTIOCYTOSIS OF THE SPINE: ANALYSIS OF 11 CASES

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Abstract:

Langerhans cell histiocytosis of the spine is a rare lesion, and therefore appropriate diagnosis and management are still challenging.

Aims

To report clinical and roentgenographic findings, and to evaluate the results of different treatment methods.

Materials and methods

Clinical and roentgenographic findings of 11 patients, with average follow-up of 3,2 years, were analyzed. The results of treatment were assessed clinically and radiologically. Anterior vertebral body height was measured sequentially to evaluate reconstitution of the vertebral body.

Results

The last follow-up examination demonstrated no clinical evidence of disease in 10 patients, regardless of treatment method. In all patients was a single system disease with only two with multiple bone involvement. Satisfactory restoration of height was demonstrated in all except two vertebrae. We didn't have neurological deficit on initial presentation in our serie.

Conclusion

In most of the cases, observation with or without bracing seems to be sufficient. In patients with multifocal lesions, chemotherapy and sometimes radiotherapy produces good results.

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LUMBAR SPINE EPENDIMOMA MIMICKING STRESS INCONTINENCE – CASE REPORT

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Abstract:

We are presenting a case of patient, 67 years of age with a history of sphincter problems. She had two surgeries at the Urological Clinic under the diagnosis of stress incontinence without recovery and is still catheterized. After surgery, she reported difficulty with walking accompanied with weakness in lower extremities, and a necessity for walking aids. Thorough examination was made (laboratory analysis, radiological, scintigraph, MRI). She was examined by a spinal and neurosurgeon, and was diagnosed with a intraspinal tumor in L1-L2 segment. A pathological fracture of the L3 vertebrae was also noted. The surgery was indicated and preformed together with the neurosurgeon. The stabilization of the spine was performed, the tumor was extracted from the dural sack and detached from the nerves of the cauda equina. Two biopsy samples were acquired – one from the tumor and the other from the bone of the fractured L3 vertebra. Pathohistological verification identified the tumors as the ependimoma and the bone tissue of the fractured vertebra showed no pathological changes. Postoperative neurological recovery showed that the primary cause of the sphincter disorders were caused by the tumor proliferation. This indicates the necessity for additional diagnostic procedures especially the necessity for MRI of the lumbosacral region of the spine in stress incontinence patients.

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GCT OF THE SACRUM, SERIES OF 8 CASES

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Aims

Giant cell tumor (GCT) of bone is a rare neoplasm that accounts for approximately 5% of all primary bone tumors and about 3–4% of all GCT's involve the sacrum. Due to the rare appearance of the sacral GCT's, there are very limited data in the literature about their nature, diagnosis and treatment. Our objective was to retrospectively analyze the radiological findings, clinical characteristics, surgical treatment and outcome of 8 sacral GCT cases treated surgically in the National Center for Spinal Disorders (NCSD).

Materials and methods

We retrospectively reviewed the NCSD Primary Tumor Database and collected all cases of sacral GCT's focusing on the clinical and follow-up data.

Results

Our institutional RedCap database contains 111 sacral tumors with only 8 sacral GCT's. These patients were operated over a seven year period. The mean age of the patients was 26 year (12-51) at the time of diagnosis. The male/female ratio was 5/3. Severe pain was the most common first symptom of the lesions. This was accompanied with neurological deficit in 4 cases. Intralesional gross total resection had been performed in most of the cases (6/8) while the lesion was en bloc resected only in two cases. There were no serious surgical complications in our cohort. The median clinical follow up of the cohort was 2.14 years (0.1-5.54 years). There was only one local recurrence which was treated surgically. In August 2012, all patients were still alive, disease and symptom free.

Conclusion

The treatment plan of GCT's should take in consideration the cost-benefit aspects of an en bloc resection with possible functional and neurologic deficits and the safer other techniques with a possible higher recurrence rate.

WOUND HEALING COMPLICATIONS OF SACRAL CHORDOMA RESECTIONS IN ELDERLY

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Aims

Chordoma of the sacrum is a rare, low-grade, primary malignant bone tumor with notochordal origin. Negative margins during surgery favorably correlate with the rate of local recurrence and survival, however en bloc resection is marked by significant perioperative morbidity, especially at patients older than 65 year. Our objective was to assess the wound healing complications after sacral tumor surgery in the elderly patients who were treated surgically in the National Center for Spinal Disorders (NCSD). The secondary objective was to perform a literature review of the complications after sacral chordoma resection and compare our findings with the few published cases.

Materials and methods

We studied 45 patients with sacral chordoma treated between 1995 and 2011. The assessed variable was the patient's age. This was followed by the literature review.

Results

The most frequent complication was wound healing problem, it occurred in 38% of the patients. By comparing the elderly patient group (≥ 65 year) with the younger patients (< 65 year) we found that the majority of the wound healing problems (80%) developed in the elderly population. This was found to be statistically significant ($p < 0.01$). Other complications like vascular injury, urinary or systemic infection and deep vein thrombosis occurred in 2% of the patients. One patient died in the perioperative period. Our findings are in concordance with the literature data.

Conclusions

There is an increased incidence of post-operative wound healing complications among patients ≥ 65 years of age. Additional prospective studies are required assessing operative outcomes in elderly vs. younger patients to confirm the conclusions presented here.

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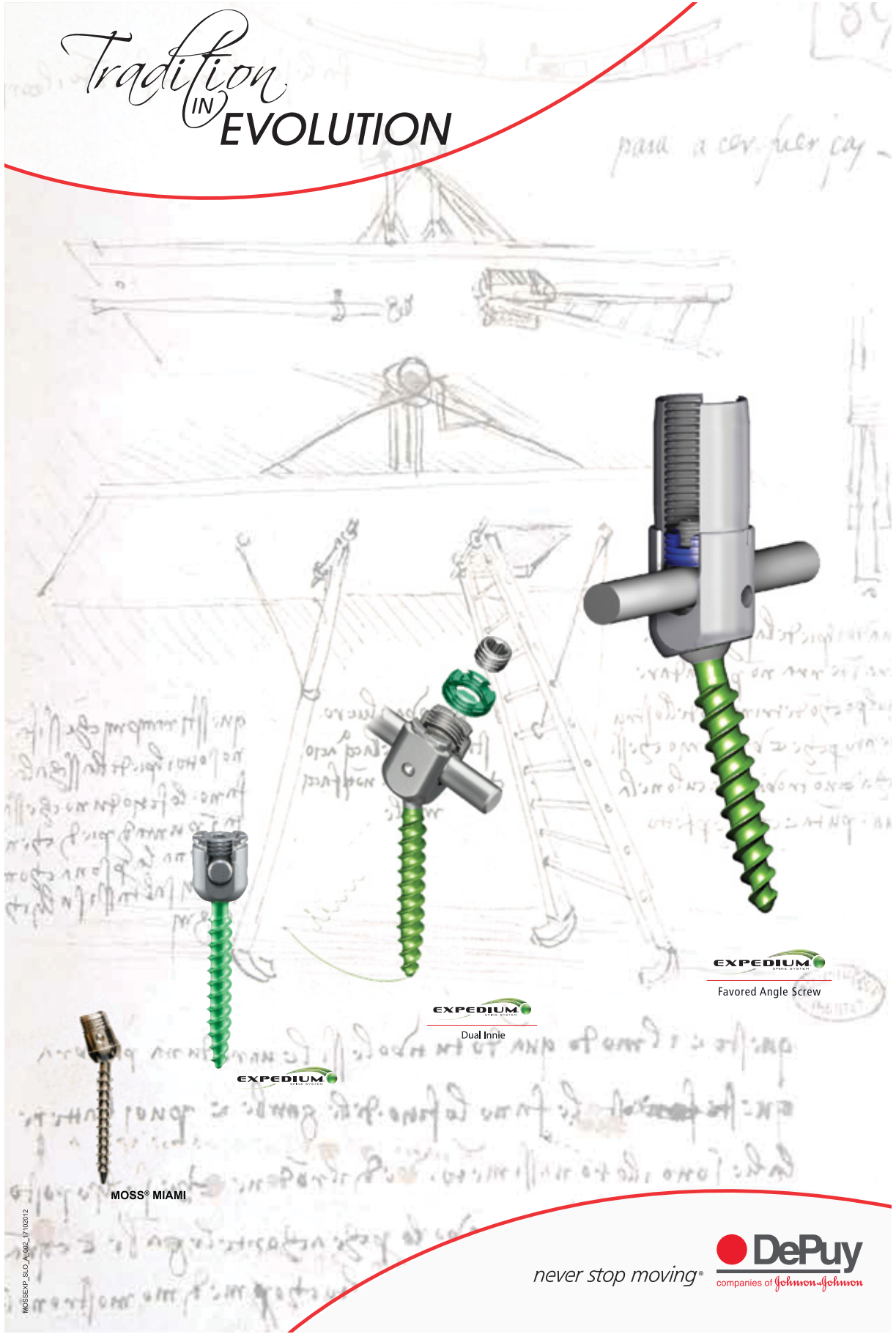
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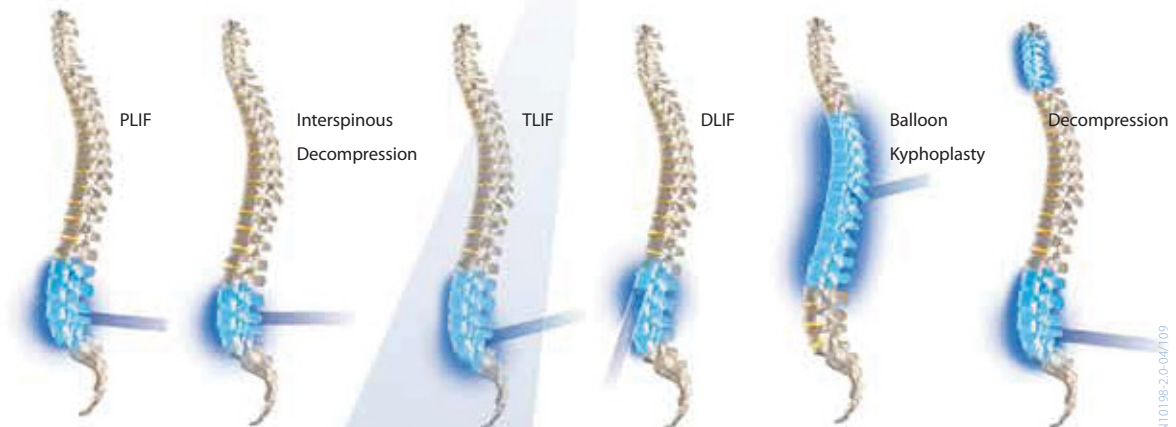
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