"Use of Biological Solutions for Annular Healing: Dervan Platelet Fibrin Plug in Transforaminal Disc Surgery."

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I. Introduction

Biological treatment approaches recently have shown encouraging results in degenerative disc disease and additional relief in back and leg pain. Stitchless endoscopic transforaminal surgery under local anaesthesia is a paradigm shift in spine surgery for disc degeneration. Ability of a surgeon to identify pain generators in patient under local anaesthesia is its core. The “in vivo visualization” of etiopathology in degenerative lumbar spine and probing pain generators in real time revolutionized disc and spine surgery by increasing certainty of diagnosis and resulting treatment planning.

One of the main limitation in transforaminal endoscopy is entry thru the annulus foramen by blunt dilatation of the annular fibres creating a new rent in annulus. Comparison of using working cannula in annulus, a circular incision or a square incision in annulus has showed less destruction of annulus fibrosus by working cannula. Use of working cannula helps in maintenance of biomechanical strength and repair of annulus fibrosus. But a small residual annular defect needs treatment to close it at end of surgery.

Annular tear is a fundamental change in symptomatic disc to bring nuclear tissue in touch with neurovascular supply of the disc. Chronic annular tear causes symptoms of back and leg pain. The main component is “inflammation”. This has been variously treated by instilling locally active anti-inflammatory agent or removing cause of the inflammation, that is a trapped piece of nucleus in the torn annulus. The torn annulus needs treatment in form of a healing stimulus to relieve symptoms.

The present study is for both these issues. We utilised basic access of transforaminal endoscopy to access and visualize the pain generators and deliver anti-inflammatory “biological solution” at site of pain generation and second at end of intervention tried to cover the iatrogenic annular defect with a biological autologous solution.

IN our study standardised protocol and equipment to obtain a reasonable quality platelet fibrin plug was evolved. We have investigated if this autologous fibrin plug in and around annular tear and around the root can reduce early postoperative discomfort, pain and spasm and later help local healing of annuluar tear and rent and patient’s symptomatic recovery.

II. Method

26 stitchless disc surgeries were done under local anaesthesia by inside out YEUNG and GORE technique for the standard indications under C arm guidance with the patient in prone position. The needle was introduced into the foraminal portion of the targeted disc from about 10-12 cm from the midline. Thereafter the insertion of guide wire then a dilator to bluntly dilate annular fibres to gain an entry inside the disc and finally a working cannula of 7.6 mm diameter was followed. A working channel endoscope [Gore system® Karl Storz endoscopy] was then introduced and targeted fragmentectomy was performed.
Pre-Operative MRI Depicts Problem We Treat by Stitchless Surgery Under Local Anaesthesia. Stitchless Surgery Scar at End of 1 Year. Left Side Access to Intervertebral Foramen at L45. Black Arrow

Autologous platelet fibrin plug preparation protocol in the present study.

About 15 ml of blood is drawn and immediately (before clotting cascade is triggered i.e. less than a minute and without any anticoagulant) transferred to a autoclaved plain glass tube with a cap and centrifuged at 3000 rpm for 10 minutes. Thereafter a standing time in the centrifuge of 10 minutes is allowed. Using aseptic precautions, the tube is then uncapped by the circulating theatre personnel and the plug is lifted from the tube and is ready for insertion (Photograph 1,2) through working cannula at symptomatic annular tear or annular rent. This plug is placed in the cannula and pushed into the disc using the dilator (photograph 3,4,5) to seat it at annular defect or rent at the end of the procedure. Early outcome of surgery and use of plug was measured by VAS scale, Oswestry disability index. Case records were reviewed for any adverse events.

Photograph: 1. Blood in the tube after centrifugation of 3000 rpm for 10 min and 10 min of standing time, separated in three fractions, upper fraction of acellular layer, middle of PRF and bottom fraction of RBC’s

Photograph: 2. Platelet Rich Fibrin Plug immediately after standing time of 10 min, ready for insertion.
Photograph: 3. Platelet Rich Fibrin (PRF) plug inserted in the cannula at the end of stitchless disc surgery under local anaesthesia. 4. Platelet Rich Fibrin (PRF) plug inserted into the disc through the cannula with the help of dilator pusher. 5. 3.3cm PRF plug obtained from 15ml whole blood volume, were directly inserted into the disc at site of annular tear and rent.

III. Results

Total 26 patient’s surgical outcomes are presented in the study. 46% of the patients were males whereas 54% were the females with the average age of 38.7years & 58.7 years respectively. There were no adverse events in this study from the use of the platelet fibrin plug, hereafter called Dervan plug.

The mean VAS score for pain, showed significant improvement by 73% (Figure:1).

| Preoperative 9.3 and Postoperative 2 |

Modified version of ODI questionnaire was converted to local Marathi language for better understanding of local patients. The average pre-operative ODI was calculated as 83% whereas post-operative ODI score showed 62% decline to 21% score(Figure:2).

Figure: 2. ODI comparison between Pre and Post-Operative Average score. Graph shows 62% of average reduction in post-operative ODI Score,
### Case Study No.1

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<td>65/F</td>
<td>PIVD L4-L5, L5-S1, B/B Relatives with H/O Low Back Ache, C/O: BA+ Radiating to L1/L2. L1 Severe.</td>
<td>Percutaneous Lumbar Endoscopic Discectomy</td>
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### Case Study No.2

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<td>CID L3-L4, L4-L5 B/B Relatives with C/O: Low Back Ache Radiating to L1/L2/L3</td>
<td>Lumbar Endoscopic Discectomy</td>
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### Case Study No.3

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<td>53/F</td>
<td>L4-L5 CID B/B Relatives with C/O: Low Back Ache Radiating to L1/L2/L3 associated with weakness and T/N</td>
<td>Percutaneous Lumbar Endoscopic Discectomy</td>
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The use of Dervan plug as a local wound sealant helped to reduce pre surgical lumbar pain. Improvement in quality of life of these patients was satisfactory. However, in order to establish a correlation between surgical outcomes of surgery and use of Dervan plug of platelet rich fibrin further comparative study with the help of radiological analysis was done. The posterior annular outline was studied in post op MRI and 3 illustrative cases are shown above with excellent results in symptoms and images.

IV. Discussion

The cost of preparation and expertise and equipment (INR 5 for the test tube & 5000 for the portable centrifuge alongwith a recurring cost of INR 15 per use of electricity, sterilisation & use of sterile syringe to extract blood by venepuncture etc.) is minimum and equipment is readily available. It is a safe quick and successful method of obtaining a bioactive plug for healing of the annulus.

We have been able to establish a simple protocol to get a sizable Dervan plug for our use during and at end of surgery. Our ability to remove the causative nuclear fragments trapped in annular fibres and instilling plug at the tear has added to post-operative relief of pain and discomfort and early return to normal mobility. The pre and post-operative images were compared and they showed satisfactory healing of the annulus.

In vitro evidence suggests platelet rich plasma would accelerate local healing. We have limited experience of injecting plasma inside and around the disc. Platelet rich fibrin plug has been shown to be useful in vitro and vivo to accelerate healing of tissues. It was first introduced by Choukren et al in dentistry for enhancement of bone matrix formation before implantation etc.in year 2001. It is autogenic and the time...
required for preparation is short (20 minutes by our modified technique). Corso et al.\textsuperscript{17} proposed that PRF acts as bioactive material in dental practices, a blood clot for neovascularisation and promote the tissue architecture.

In vitro study\textsuperscript{18 19} shows PRF supporting bone morphogenic protein releases cytokines and number of potential growth factors (e.g. PDGF-AA, PDGF-BB, TGF-β, BFGF, VEGF, IGF, bFGF etc.) accelerates the collagen system and promote fast healing of the soft tissue. These released growth factors from PRF could stimulate cell proliferation, fibroblast production, chemotaxis, gene expression and promote the accumulation of ECM, cell migration and angiogenesis. Release cytokines plays key role in the regulation of inflammation phenomenon. From the evidence available from in vitro studies it is expected to orchestrate and accelerate local healing of tissues.\textsuperscript{20 21}

Short term studies have demonstrated the positive effect on post-operative pain, spasm and discomfort. Further long term studies can evaluate if the in vitro evidence of the stimulant effect of platelets translates into appreciable clinical benefit in terms of healing of the disc and changes in long term outcome after discectomy. The present report is encouraging and should allow us to design more studies with confidence to determine the place of platelet rich fibrin Dervan plug in discogencichack and leg pain.

Platelet rich plasma injections have been tried in patients with chronic back pain with good results.\textsuperscript{22} We did not find any reports in the literature of the use of PRF (Platelet rich fibrin) in spine surgery. The present case series is the first report in the literature as far as we are aware of in vivo use of PRF following discectomy and our experience over the last 24 months in inducing healing of the torn annulus and degenerate nucleus pulposus.

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References