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RESEARCH ARTICLE

ASSESSMENT OF LUMBO-PELVIC STABILTY IN TENNIS PLAYERS.

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Key words:-
Lumbo-Pelvic Stability, Core Strengthening, Tennis players, Low back pain, Stabilser Pressure Biofeedback Unit.

Abstract

Aim of the study was to assess the Lumbo-Pelvic Stability in Tennis players.

Method: An assessment based cross sectional study was done with Purposive sampling technique. A total of 26 subjects were divided according to the years of experience in the game of Tennis. Group A consisting of 12 subjects with (<=5) years of experience (Recreational tennis players) & Group B had14 subjects with (>= 5) years of experience (Professional tennis players). Subjects were assessed using self made questionnaire and Pressure Biofeedback Unit (testing of lumbo-pelvic stability (Richardson and Jull's grading). Subjects with previous/ existing history of severe musculoskeletal pathologies (spinal fracture, structural scoliosis, abdominal surgery) were excluded from the study.

Results: On comparison of Lumbo-Pelvic Stability scores between Recreational and Professional Tennis players, the results exhibited a significant correlation using non-parametric Chi square test, with p value ($p<0.05$). On comparison between Group A & Group B, the latter attained higher Lumbo-Pelvic stability scores of 2a and 2b (Richardson & Jull's grading) corresponding to the relative differences of 8% and 43% respectively. The result also showed significant correlation ($p<0.05$) between Core Strengthening exercises and higher Lumbo-Pelvic Stability scores in Professional Tennis players.

Conclusion: Professional Tennis players attained higher Lumbo-Pelvic Stability (LPS) scores as compared to Recreational Tennis players.

Introduction:-

In the kinetic chain of Tennis strokes, trunk stability plays a vital role, being part of the force generation and transmission.[1] Lumbo-Pelvic Stability (LPS) is the capability to control motion of lumbar spine and pelvis in neutral. [2] High amplitude of LPS contributes to athletic performance by aiding in the "efficient dissemination of force generated by lower body via trunk with respect to upper body".[3] Dynamic activities like running, jumping and knocking that occur during sport activities require a stable base in the Lumbo-pelvic region to convey load along the lower limb. Synergistic activation patterns exist in LPS.[4] Excessive movement of the lumbar spine and pelvis would signify deficits in LPS and leads to musculoskeletal injury.[5] The repetitive nature of high-velocity of sprinting, stopping and pivoting during various tennis strokes, deposits repeated rotational shear and loading forces on spine, which, in turn, places the athlete at increased risk for acute and overuse injury leading to Low Back Pain (LBP). The

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mechanical stress to the spine is related to the development of degenerative disc disease in the lumbar region.[6] Improper activation and poor control of deep trunk muscles (Transversus abdominis,Multifidus) exist in asymptomatic individuals showing inability to control lumbo-pelvic stability, which is the early sign of back problems.[7,8] In Tennis players, Imaging studies of Rectus abdominis muscle volumeshows evidence side-to-side difference in rectus abdominis muscle volume, this asymmetry could reflect a greater trunk adaptation to highly asymmetrical mechanical load [9] and spinal osteoarticular changes (pars lesions, facetal arthropathy and disk pathology).[10]The stabilizer Pressure Biofeedback Unit (PBU) was used to assess Lumbo-Pelvic Stability (LPS). PBU is a device which measures the stabilizing capacity of abdominal musculature signifying LPS.[2] PBU assesses sagittal plane control of lumbar motion under an imposed sagittal load. To the best of our knowledge there is no study assessing the LPS in tennis player. The purpose of this study was to compare LPS grades using PBU in Recreational and Professional Tennis players, using Pressure Bio feedback- Unit (PBU) and self-made questionnaire.

Materials and Methodology:-

A self made questionnaire was designed for this study and was approved by Institutional research committee of D.Y. Patil University, School of Physiotherapy, Navi Mumbai and Pressure Biofeedback Unit (PBU) were used for analysis. It was an assessment based cross sectional study in which a total of 26 subjects {Group A- Recreational Tennis players, 12 subjects (<5 years) of experience in Tennis, Group B- Professional Tennis players, 14 subjects (>/=5 years) of experience} were assessed. Inclusion criteria for study were Recreational and Profession Tennis players, Age group from minimum 11yeras to maximum 56 years, both genders. Whereas, players having history of severe musculoskeletal pathology (spinal fracture, structural scoliosis, abdominal surgery) were excluded.

Procedure

Institutional Ethics Committee approval was obtained before the study. Purpose of conducting this research was explained to the participants. Consent was taken assuring to keep the identity anonymous and data collected will be used only for academic research. Participants were recruited from various tennis academies in the immediate vicinity of Nerul, Navi Mumbai. Testing of Lumbo-Pelvic Stability (LPS) was done using Pressure Bio Feedback Unit (PBU).[2] LPS was assessed in supine position with knee flexed to 70^0. PBU consist of an inflatable rectangular cushion (23x14cm) connected to a pressure gauge (measuring 0-300mmHg) and an inflation device. The cushion placed under lumbar spine (L_2-L_4) monitored the stability of lumbo-pelvic position. The cushion was inflated up to 40mmHg before starting the procedure. Prior to testing, all subjects were instructed to perform abdominal hollowing maneuver and maintain the pressure gauge at 40mmHg during the subsequent progression of LPS levels**.** There were four progressions of the test exercise. Progression from Level 1a to Level 2b, the resistance load produced by movement of legs acting on the Lumbo-Pelvic region, was increased. Any change in pressure greater than 10mmHg during the subsequent levels the trial was stopped and the subject's LPS were graded as the last level successfully completed. Following are the gradations as suggested by Richardson and Jull:

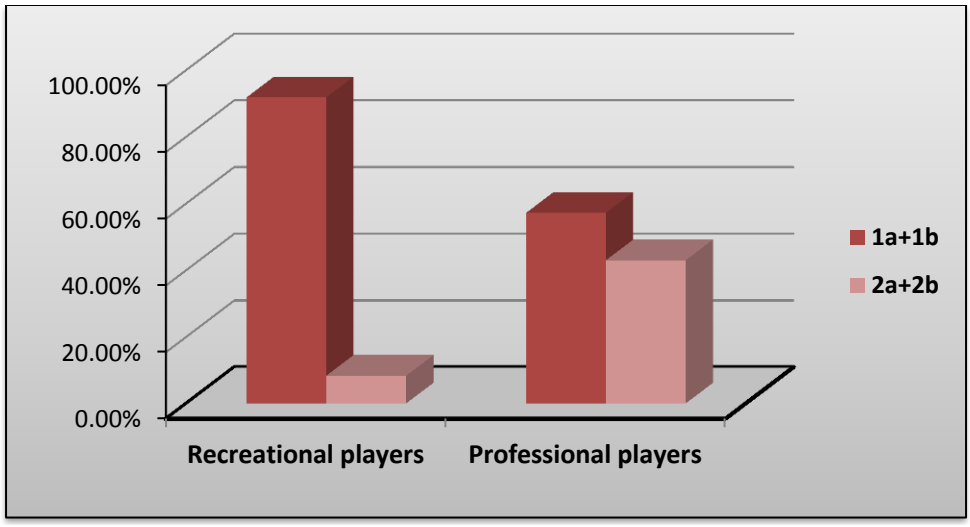
1. **Level 1a:** Unilateral heel slide along with opposite leg supported on plinth
2. **Level 1b:** Unilateral heel slide in which, limb will be 5cm off the surface while opposite leg will be supported on the plinth.
3. **Level 2a:** Unilateral heel slide while opposite leg will be 5cm off the surface
4. **Level 2b:** Unilateral heel slide with foot 5cm off the surface while opposite leg will also be 5cm off the surface.

Statistical analysis was done using R-software (Version-3.5.1). Descriptive statistics were used. Data was analyzed using Chi-square test.

Statistical Analysis

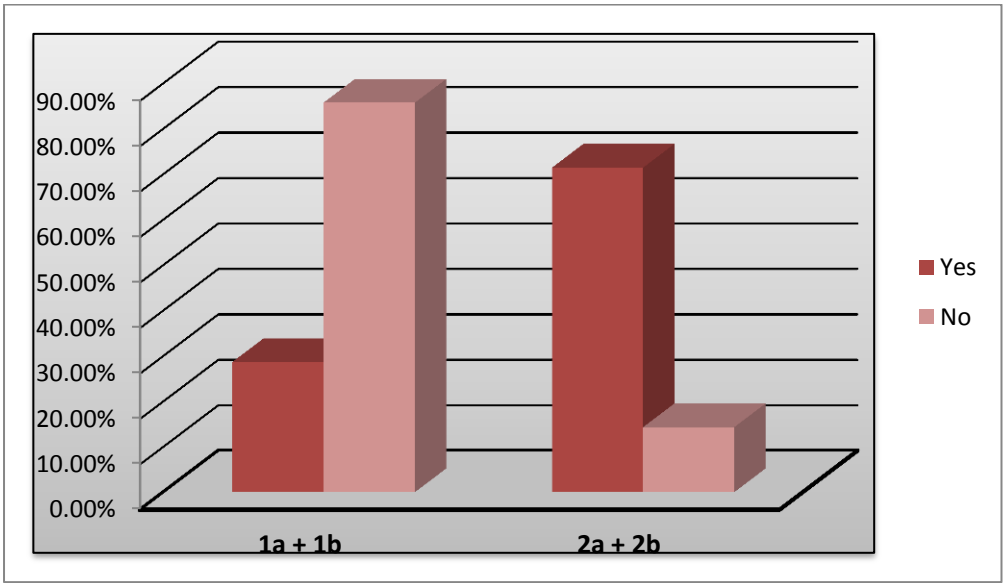
Graph 1-Comparing grades of Lumbo-Pelvic Stability (LPS) between Group A and Group B:

Group A- Recreational Tennis players having (<5 years) of experience, Group B– Professional Tennis players having (>/=5 years) of experience.



	LPS Grading (1a+1b)		LPS Grading (2a+2b)	
	Count	Percent	Count	Percent
Group A (Recreational players)	11	91.7%	1	8.3%
Group B(Professional players)	8	57.1%	6	42.9%
Chi-Square test (p-value)	3.914 (0.048)			

Graph 2:-Correlation of Lumbo-Pelvic Stabilty (LPS) grading and Core strengthening exercises in subjects of Group B: Group B – Professional Tennis players having (>/=5 years) of experience



	Number of subjects performing core strengthening exercises (Yes)		Number of subjects not performing core strengthening exercises (No)	
LPS Grading	Count	%	Count	%
1a + 1b	2	28.6%	6	85.7%
2a + 2b	5	71.4%	1	14.3%
Chi-Square test value (p-value)	4.667 (0.031) – Significant association			

Results:-

26 Tennis players were recruited for this study, of which 12 Recreational players formed Group A i.e. players having (<5 years) of experience in Tennis and remaining 14 Professional players formed Group B i.e. players having (>/=5 years) of experience. At baseline there was significant difference seen in the categories of Age and Weight (kg) between Group A and Group B, whereas, for height (m) and BMI (kg/m^2) there was no significant difference seen between the groups.

Baseline measures of Group A and Group B

Mean Values	Height	Age	Weight	BMI
Group A (n=12)	1.61	17.42	66.17	26.28
Group B (n=14)	1.67	30.21	70.86	26.01
Grand Total (n=26)	1.64	24.31	68.69	26.13

Results on comparison of Lumbo-Pelvic Stability (LPS) scores between Group A and Group B, showed significant correlation using a non-parametric Chi square test, with p value (probability value) less than 0.05 ($p<0.05$). Professional players attained higher LPS scores of 2a and 2b (according to Richardson and Jull's grading) when compared with Recreational players, which correspond to relative differences of 43% and 8% respectively. The result also showed significant correlation ($p<0.05$) between core strengthening exercises and higher LPS scores in Group B. For comparison of LBP during serve amongst the groups, repeated Chi square test reveled significant correlation ($p<0.05$), 28% of Professional players experienced LBP during the execution of serve, whereas, none of the Recreational players experienced LBP during the serve.

Discussion:-

The purpose was to compare Lumbo-Pelvic Stability (LPS) in Tennis players falling under two groups: Group A - Recreational Tennis players having (<5years) of experience and Group B- Professional Tennis players having (>/=5 years) of experience, using stabilizer Pressure Biofeedback Unit (PBU) and self-made questionnaire. In this study there exists a difference in the LPS levels attained by Recreational and Professional Tennis players. The stabilizer PBU measures the pressure applied by lumbar spine on a pressure cuff inserted in the space between lumbar spine and plinth. A decrease in pressure more than 10mmHg symbolizes an inability to sustain isometric contraction of abdominal muscles. The assigned LPS score ultimately measures the amount of impairment present: participants with high degree of impairment will obtain a low level in test exercise while those with a low degree of impairment will obtain a high level in test exercise. Professional players attained higher LPS scores than Recreational players indicating, with increased years of experience in tennis, Professional players attained higher levels of LPS scores.There was a positive correlation between Core strengthening exercises and higher LPS scores. Professional players involving in regular core strengthening exercises (side bridging, bridging on ball, crunches, curl-up) attained higher levels of LPS scores as compared to recreational players. Co-contraction of the trunk flexors and extensors has been found to increase the stability of the spine.[11] Multifidus ,transversus abdominis muscles act not only as lumbar stabilizer but also as a pelvic stabilizer.[12] Core strengthening exercises promote isometric contraction of transverses abdominis, lumbar multifidi and pelvic floor muscles, which decrease compensatory muscle activation leading to increased LPS.20% of professional players had LBP while performing serve despite having higher LPS scores as compared to recreational players. In the event of Professional match, a minimum number of 35 serves, characterized by short explosive burst of energy, repeated over number of times during the match, leading to overuse injury[13] (in the posterior elements of the lower lumbar spine) resulting in higher amount of spinal loads. The serve involves high trunk motion speeds and imposes spinal loads of up to nearly 3000 N (approximately 305.81 kg).[14] The serve presents significant trunk musculoskeletal demands, mostly during the wind-up phase, where players perform a trunk lateral flexion, hyperextension and rotation movement.[15] Studies on lumbar kinematics during the tennis serve shows greater lateral flexion moments in players with LBP, which may be a potential injury mechanism.[16,17]This allows greater retention of elastic energy for the acceleration phase, it deposit greater levels of stress on posterior spinal structures and is the contributing factor for spondylolysis in Tennis players.[18]In a study on MRI findings on lumbar spines, significant proportion of elite tennis players had asymptomatic pars injuries, some of which are acute or chronic stress responses due to increased rotation, flexion, and extension forces of lumbar spines eventually leading to LBP in Tennis players[19]. The study shows very few professional tennis players indulge in speed and agility training. Tennis demands athletes to have fast reaction time and therefore these players must be exceptional multidirectional movers in addition to linear and lateral directional movers. Speed and agility training

challenges the core, creates better balance, increases reactive time and improves cardiovascular efficiency. Players might indulge in overtraining causing inappropriate recovery time and overloading stress injuries in core muscles leading to early fatigue, abnormal trunk muscle recruitment patterns and impaired injury protection mechanism. All the former reasons can be the causes of LBP in professional Tennis players. These interpretations clearly indicate that sports physiotherapist should modify the training regime for tennis players. Therapist should mainly focus on truck co-contraction patterns and endurance of abdominal muscles, these have been shown to increase spinal stability and decrease the spinal loads.[20] exercises must be performedthat simulate the movement patterns of a given tennis strokes.[21]

Conclusion:-

In this study, Professional Tennis players attained higher Lumbo-Pelvic Stability (LPS) scores as compared to Recreational Tennis players.

Limitation

1. Limitations of the study were the smaller sample size thus reducing the generalization.
2. Real time Ultrasonography can be used to visualize muscle action during various phases of serve.

Future Scope

1. Study should include players from various transitional phases of training in Tennis (beginner's stage, intermediate stage, advance and super advance stage).
2. Detailed analysis of phases of serve and various strokes in Tennis.

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