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Stability of Arthrocentesis Syringes: A Comparison of the Conventional, Three-Ringed, Reverse-Aspiration, and Reciprocating Procedure Syringes

Category: Research Methodology

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PURPOSE: Syringe procedures are increasingly used for the diagnosis and therapy of joint disease, yet the stability and safety of procedure syringes have not been studied in a systematic way. We hypothesized that the finger position on the barrel flanges and the direction of the vector force on the syringe barrel would determine the stability or instability of a syringe during a particular syringe cycle. The Purpose of our study is to determine the stability, force vector, finger position, aspiration, and injection characteristics of the conventional, reverse aspiration, the three-ringed, and the reciprocating procedure syringes.

METHODS: 10 physicians with extensive syringe procedure experience tested the above syringes in following syringe maneuvers including aspiration, injection, injection-aspiration, and generation of vacuum to a defined level. The new reciprocating procedure syringe was obtained from DuoProSS ((DuoProSS Meditech Corp. 27 Sarah Drive, Farmingdale New York USA). Instability and loss of control of the syringes were measured by the number and depth of needle penetrations through an organ model simulating both the intended control point and unintentional perforation in human tissues during a procedure. Positive and negative pressures generated by the syringes were measured with a digital manometer, and operator difficulty with each syringe was measured with an analogue scale.

RESULTS: Instability (complete perforations per 10 injection-aspiration cycles) was as follows: reverse aspiration syringe 9.0 ± 1.2 , conventional syringe one-handed 5.5 ± 1.2 , conventional syringe two-handed 2.0 ± 1.5 , the 3-ringed syringe 2.6 ± 2.2 , and the reciprocating syringe 0.8 ± 0.9 ($p < 0.005$). The finger position the barrel flanges and the direction of the vector force on the syringe barrel accurately predicted the stability of each syringe ($r = .93$, $p < 0.005$). All syringes were similar in difficulty of pressure generation, but reciprocating syringe was much easier to generate a defined level of vacuum than the other syringes ($p < 0.005$).

CONCLUSIONS: Procedure syringes are highly unstable and dangerous with very high perforation rates. One-handed use of the conventional syringe in the aspiration mode is especially unstable and should be avoided in syringe procedures. The reciprocating syringe demonstrates markedly superior stability, ease of use, vacuum generation, and injection-aspiration characteristics compared to other procedure syringes, including the conventional syringe used with two hands, and has great potential as a general purpose procedure syringe for joint disease.